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FIXED FACILITIES ENERGY CONSUMPTION INVESTIGATION INITIAL ENERG--ETC(U)
JAN 78 L M WINDINGLAND, B J SLIWINSKI

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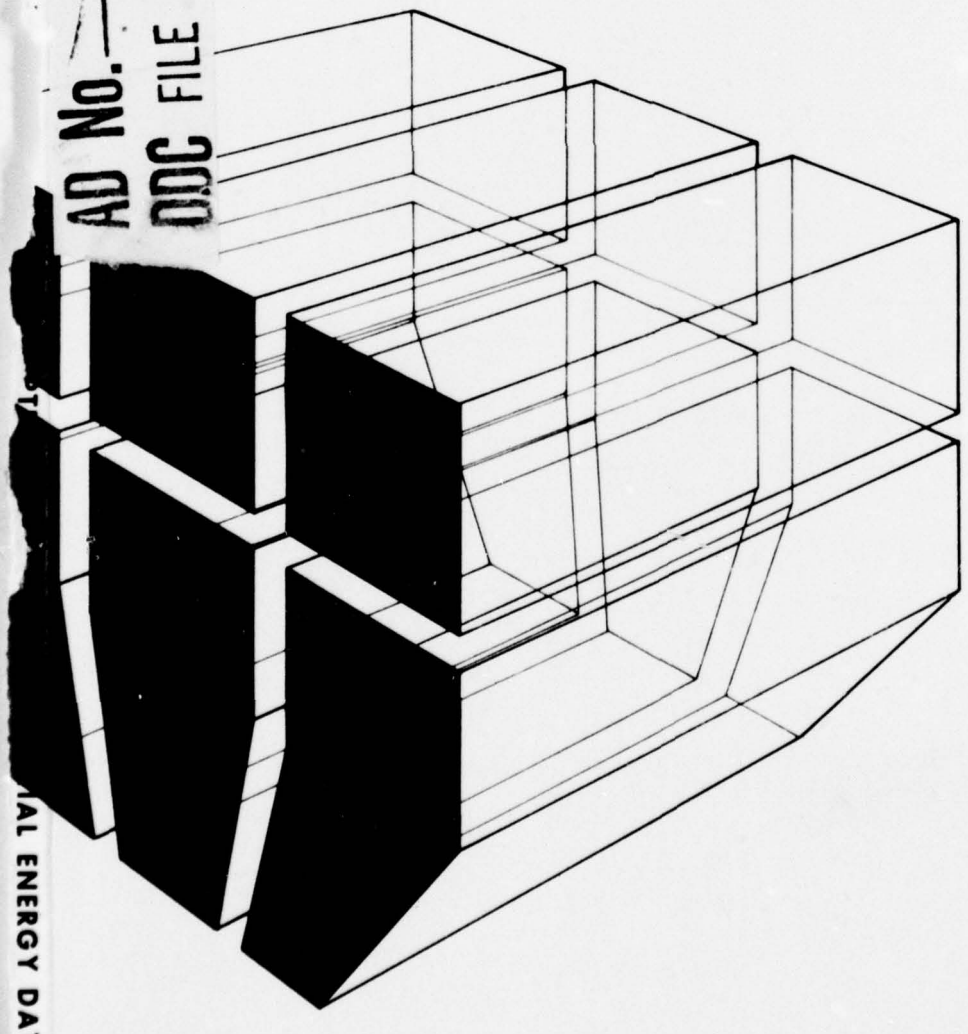
January 1978
Fixed Facility Energy Consumption Investigation

FIXED FACILITIES ENERGY CONSUMPTION INVESTIGATION—INITIAL ENERGY DATA



by
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This report describes energy consumption data obtained between December 1976 and March 1977 for 45 Army buildings being monitored at Fort Belvoir, VA, Fort Carson, CO, and Fort Hood, TX, as part of a study being conducted to identify energy consumption patterns at fixed Army facilities. The 45 buildings represent six of the major energy consumer groups found on Army installations: family housing, troop

Block 20 continued.

housing, administration/training buildings, production/maintenance buildings, medical/dental buildings, and community support facilities. This report provides potential users of energy data with preliminary findings and indicates the formats and analysis techniques which will be used in a full-year energy-consumption data report to be published in FY78. Consumption data for electrical energy and fossil fuels are presented as monthly energy-consumption totals for the six energy consumer groups. The electrical data for each building are analyzed by computing the daily usage per unit area. The heating energy use for various buildings is compared by computing the energy used per unit area per heating-degree day. Typical daily and monthly usage profiles are presented for each energy consumer group.

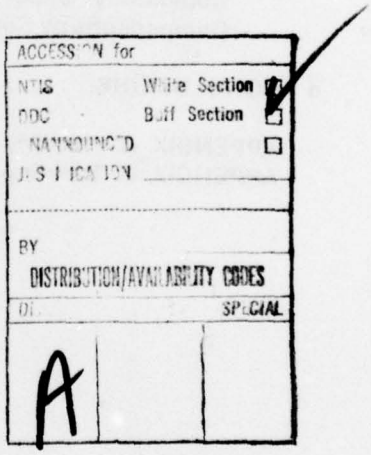
FOREWORD

This work was performed for the Directorate of Facilities Engineering, Office of the Chief of Engineers (OCE), under Project 4A762731AT41, "Design, Construction, and Operation and Maintenance Technology for Military Facilities"; Technical Area 06, "Energy Systems"; Work Unit 007, "Fixed Facility Energy Consumption Investigation." Mr. J. Walton served as the OCE Technical Monitor.

This work is a joint effort of the U.S. Army Facilities Engineering Support Agency (FESA) and the Energy Branch (EPE), Energy and Power Division (EP), U.S. Army Construction Engineering Research Laboratory (CERL).

Appreciation is expressed to Mr. Andrew Mech (mathematician) of CERL for his assistance in accumulating the data and preparing the curves.

COL J. E. Hays is Commander and Director of CERL and Dr. L. R. Shaffer is Technical Director. Mr. R. G. Donaghy is Chief of EP and Dr. D. J. Leverenz is Chief of EPE. COL R. Miller is the Commander and Director of FESA and Mr. C. Smith is the Technical Director.



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FIXED FACILITIES ENERGY CONSUMPTION INVESTIGATION—INITIAL ENERGY DATA

1 INTRODUCTION

Background

At the onset of the energy crisis in 1973-74, the Army did not have an understanding of how, where, or when energy was being used in its individual, fixed facilities. Metering of individual buildings to monitor energy consumption occurred only where the installation was to be financially reimbursed for the energy. The increased cost of fuel and electricity affects the installation operations budget and attracts the attention of installation commanders, major commands, and the Office of the Chief of Engineers (OCE).

OCE therefore initiated a study of the energy problem on Army fixed facilities.[1] As various areas for investigation were identified, it became apparent that a knowledge of the energy consumption patterns of the facilities on Army installations was required.

Objective

The objectives of this study are (1) to collect data relating to the flow, demand patterns, and uses of the various forms of energy consumed on Army installations, (2) to compile a data file for use in later analysis, and (3) to analyze the collected data to determine how the energy was consumed, identify conservation measures, and improve energy utilization.

The objective of this report is to provide energy data users with (1) an initial summary of the energy use data that have been collected in this study and (2) a preliminary analysis of the data with respect to building type and climatic conditions.

Approach and Scope

This study is being conducted in the following steps:

1. Determination of potential Army users of energy usage information and their data requirements

2. Selection of specific Army posts and major consumer groups for monitoring based on size, geographical location, weather, mission, and major command

3. Selection of specific buildings in each major consumer group for application of instrumentation

4. Selection and procurement of required instrumentation and monitoring systems to record energy use on an hourly basis

5. Installation of instrumentation and interfacing and recording equipment at energy sensor locations

6. Development and maintenance of a data base management system for storage, retrieval, and analysis of energy consumption data

7. Provision of potential users with reports and information for using the energy consumption data in their studies.

Steps 1 through 6, which are described briefly in Chapter 2, are detailed in the *Fixed Facilities Energy Consumption Investigation (FFECI) Data Users Manual.*[2] The present report is a first effort in completing step 7. Because 110 buildings containing over 400 individual monitoring points are being monitored on an hourly basis, a meaningful presentation of the raw data for the approximately 3,500,000 data points in a 1-year period would be impossible. Summarizing the data to reduce the volume to a reportable size was therefore necessary. This report provides an initial summary of energy use data collected during the study (December 1976 to March 1977) and a preliminary analysis of the data. It does not cover data from all data monitoring points, but rather from a selection of 45 buildings which are representative of most of the energy consumers on a post. The data in this report, although indicative of preliminary trends, do not constitute a sufficient sample for immediate field application.

The format used to present the preliminary data in this report is indicative of the manner in which the

[1] Disposition Form, Subject, Energy Consumption Investigation (Research and Development Office, Office of the Chief of Engineers, 26 August 1974).

[2] L. M. Windingland and B. J. Sliwinski, *Fixed Facilities Energy Consumption Investigation Data Users Manual,* Interim Report E-122 (U.S. Army Construction Engineering Research Laboratory [CERL], 1977).

full year's energy consumption data will be summarized and produced. The full-year report will also include cooling energy usage, since the data will extend through a summer cooling season.

Organization of Report

Chapter 2 briefly describes the initial steps in the study, discusses selection of the buildings for inclusion in this report, and provides information on how to obtain additional detailed energy consumption data. Chapter 3 provides a preliminary analysis of the energy consumption data and reports the preliminary findings for each consumer group studied. Typical daily and monthly energy use profiles are provided for each consumer group.

The appendices provide more detailed information. Appendix A shows the monthly consumption of each building and data points selected for analysis, and Appendix B provides a description and photograph of each building.

2 DISCUSSION

Initial Steps of Study

The first step in the study was to define the users and uses of building energy data. The military users were defined as facilities engineers, Major Command and Corps District and Division Engineers, OCE, and research laboratories. The needs of these users range from yearly consumption totals for various building types to hourly energy usage patterns for detailed building energy consumption analysis. This variety of needs necessitated use of metering devices that would record building energy consumption on an hourly basis.

Since all Army buildings could not be monitored, the next step was the selection of a representative sample of installations and buildings. The three Army posts selected were Fort Belvoir, VA, Fort Carson, CO, and Fort Hood, TX. These installations represent two major Army commands (TRADOC and FORSCOM) in order to provide data on facility energy use on posts with different missions; the two posts in the same command (Fort Carson and Fort Hood) are differently sized, thus permitting determination of the effects of size on energy use profiles. In addition, the posts are in different geographical areas, which enables study of differences in energy use for various building construction types (e.g., block vs. frame) and insulation levels in different climates.

To select the buildings to be monitored on each installation, Army buildings were divided into consumer groups based on the Army real property indexing system, which separates facilities into over 40 different building categories. These 40 categories were consolidated into eight major energy consumer groups representing different post functions: troop housing, family housing, administration/training buildings, production/maintenance buildings, storage buildings, medical/dental buildings, community support facilities, and portions of each post's utility distribution system. Nearly every building on the three Army posts falls into one of these eight consumer groups.

Individual buildings in each consumer group were selected for energy usage monitoring on each installation. The selection was based primarily on the construction type and the construction era (e.g., World War II type, 1960's I-type, and modern Army standard design types were selected in the troop housing category). In some instances, identical buildings were chosen for comparison of life-style effects and control systems variation. Also, similar buildings at two different locations were chosen to permit a consideration of weather effects on energy consumption. Table 1 lists the number of buildings of each type being monitored.

Table 1

Summary of Buildings Being Monitored

	Fort Carson	Fort Belvoir	Fort Hood	Total
Troop Housing				
Barracks	9	6	11	26
Dining Facilities	2	1	3	6
Family Housing	4	9	10	23
Administration/ Training	5	3	8	16
Medical/Dental	1	1	4	6
Storage	2	2	1	5
Production/ Maintenance	5	2	5	12
Community Support Facilities	4	5	11	20
Utility Distribution	13	11	23	47
Total	45	40	76	161

The energy parameters to be monitored in each building were then determined and the instrumentation systems and recording devices procured and

installed. The energy parameters selected generally included all energy being used to operate the buildings, such as total natural gas consumption and total electrical consumption; however, in buildings which were selected for detailed energy analysis, building temperatures, humidity, certain portions of electrical systems (such as chiller power and lighting power), and input/output operating parameters of mechanical systems were also monitored. In addition, a complete weather station at each post was selected for on-site monitoring of ambient temperature, dewpoint temperature, solar radiation, wind speed, wind direction, and barometric pressure.

Finally, a storage system was developed for filing the incoming energy use data and providing ready access to it.

FFECI Data Users Manual

The FFECI Data Users Manual[1] is available for users who wish to obtain specific energy use data. The manual describes what data are available and the methods for obtaining the data, and provides typical data examples. The manual also describes the energy data file system, and lists the buildings being monitored with their locations and the energy parameters being monitored. The instrumentation systems are fully described.

Selection of Representative Buildings for This Report

The buildings selected for this summary of the energy consumption data obtained in the initial months of the study are (1) buildings of the same size and construction to indicate differences in their energy consumption profiles, (2) old and new buildings in the same energy consumer group to permit analysis of the effect of building age and construction methods on energy consumption, and (3) similar buildings at different posts to permit analysis of the effect of climate variations. The selected buildings represent six of the eight consumer groups as shown in the summary in Table 2.

Appendix A contains the energy use for each month of valid data for the 45 buildings selected. Appendix B provides a description and photograph of each building.

[1]L. M. Windingland and B. J. Sliwinski, *Fixed Facilities Energy Consumption Investigation Data Users Manual*, Interim Report E-122 (CERL, 1977).

Table 2

Summary of Buildings Included in This Report

	Fort Carson	Fort Belvoir	Fort Hood	Total
Family Housing	2	3	5	10
Troop Housing	6	3	3	12
Administration/ Training	3	1	4	8
Production/ Maintenance	2	—	2	4
Medical/Dental	1	1	2	4
Community Support	2	2	3	7

3 ANALYSIS AND FINDINGS

This preliminary analysis is based on a comparison of energy usage for six of the consumer groups identified in Chapter 2:

1. Family Housing
2. Troop Housing
3. Administration/Training (only administration buildings from this group)
4. Production/Maintenance (only maintenance buildings from this group)
5. Medical/Dental
6. Community Support.

Comparisons are made within and between groups. The data presented are for 3- and 4-month periods between December 1976 and March 1977. Some data were not available because of malfunctioning meters.

Family Housing

Table 3 presents family housing data. Family housing units show little variation in electrical usage on a kilowatt-hours per square foot basis or gas usage on a Btus per square foot per heating degree day basis between installations, or among building types, which indicates that the usage within this consumer group is uniform and that family housing is a valid grouping.

However, data points 319 and 320, which are identical in size and construction, show a significant variation. Average electrical usage for this group is

Table 3

Energy Consumption Data—Family Housing

Fort	Data Point	Bldg. No.	Electrical Consumption kWh/sq ft/day (kWh/m²/day)	Heating Fuel Consumption, Btu/sq ft/HDD (kJ/m²/HDD)
Carson	110	17	0.0211 (0.2271)	18.9 (214.6)
	122	4644	0.0194 (0.2088)	18.2 (206.7)
Belvoir	210	1551	0.0135 (0.1453)	21.9 (248.7)
	211	1801	0.0121 (0.1302)	17.3 (196.4)
	214	579	0.0135 (0.1453)	19.6 (222.6)
Hood	319	60062	0.0151 (0.1625)	18.9 (214.6)
	320	60100	0.0173 (0.1862)	29.8 (338.3)
	322	5669	NA	10.5 (119.2)
	324	6443-1	0.0130 (0.1399)	12.6 (143.0)
	327	180	0.0149 (0.1604)	19.6 (222.5)
			Avg. = 0.0155 (0.1668)	18.7 (212.3)

0.0155 kWh/sq ft/day (0.1668 kWh/m²/day) and average energy heating fuel consumption is 18.7 Btu/sq ft/heating degree day (HDD) (212.3 kJ/m²/HDD). Figure 1 shows a typical daily electrical profile for family housing. Figures 2 and 3 show the natural gas consumption for a 2-week period versus heating degree days. Figures 4 and 5 show typical monthly electrical profiles for multi- and single-family houses.

Troop Housing

Tables 4 through 6 present energy consumption data for troop housing facilities and dining facilities. The relatively minor variation in electrical and gas usage among buildings tends to follow the building age. As shown in Figures 6 and 7, electric usage appears to increase as building age decreases, while gas and oil consumption appears to decrease with decreasing building age. The generally minor variations indicate that troop housing is a valid grouping. Again, a significant variation between buildings of identical size and construction is seen (data points 136 and 137). Figures 8 through 17 show typical daily and monthly profiles for troop housing facilities.

Administration

Table 7 gives data for administration buildings. The electrical usage for administration buildings appears to be influenced more by building type than any other factor. There is no apparent relationship between building age and energy consumption, as there was for troop housing. The electrical consumption varies from 0.018 to 0.046 kWh/sq ft/day, again a relatively minor variation, indicating that this is a valid grouping. Figures 18 and 19 show the typical daily and monthly energy use profile.

Table 4

Energy Consumption Data—Bachelor Enlisted Quarters

Fort	Data Point	Bldg. No.	Electrical Consumption kWh/sq ft/day (kWh/m²/day)	Heating Fuel Consumption, Btu/sq ft/HDD (kJ/m²/HDD)
Carson	129	1361	0.00935 (0.01006)	NA
	133	1953	0.0201 (0.2163)	NA
	136	3471	0.00661 (0.07113)	16.74 (190.04)
	137	3472	0.00739 (0.07952)	23.65 (268.49)
Belvoir	226	2111	0.0110 (0.11837)	NA
Hood	339	16008	0.0123 (0.1324)	19.2 (217.97)
			Avg. = 0.0111 (0.1194)	19.86 (225.46)

Table 5

Energy Consumption Data—Bachelor Officer Quarters

Fort	Data Point	Bldg. No.	Electrical Consumption kWh/sq ft/day (kWh/m²/day)	Heating Fuel Consumption, Btu/sq ft/HDD (kJ/m²/HDD)
Carson	119	1304	0.0155 (0.1668)	2.97 (33.72)
Belvoir	221	470	0.0230 (0.2475)	3.99 (45.30)
	222	508	0.0136 (0.1463)	16.52 (187.55)
Hood	331	36006	0.0193 (0.2077)	NA
			Avg. = 0.0178 (0.1915)	7.83 (88.89)

Table 6

Energy Consumption Data—Dining Facilities

Fort	Data Point	Bldg. No.	Electrical Consumption kWh/sq ft/day (kWh/m²/day)	Heating Fuel Consumption, Btu/sq ft/HDD (kJ/m²/HDD)
Carson	130	1040	0.0284 (0.3056)	NA
Hood	333	87017	0.0936 (1.0072)	NA
			Avg. = 0.061 (0.6564)	

Maintenance

Table 8 presents data for maintenance buildings. As might be expected, electric and gas usage is generally higher than for the other consumer groups. This higher consumption is probably caused by the

Table 7

Energy Consumption Data—Administration/Training Buildings

Fort	Data Point	Bldg. No.	Electrical Consumption kWh/sq ft/day (kWh/m²/day)	Heating Fuel Consumption, Btu/sq ft/HDD (kJ/m²/HDD)
Carson	135	1048	0.0241 (0.2593)	NA
	148	1430	0.0318 (0.3422)	NA
	154	1584	0.0407 (0.4380)	NA
Belvoir	230	399	0.0462 (0.4971)	NA
Hood	361	1	0.0213 (0.2292)	25.18 (285.86)
	365	16010	0.0235 (0.2529)	11.4 (129.4)
	370	37010	0.0186 (0.2002)	NA
	374	16011	0.0231 (0.2486)	23.95 (271.90)
			Avg. = 0.0287 (0.3088)	20.18 (229.10)

Table 8

Energy Consumption Data—Maintenance Buildings

Fort	Data Point	Bldg. No.	Electrical Consumption kWh/sq ft/day (kWh/m²/day)	Heating Fuel Consumption, Btu/sq ft/HDD (kJ/m²/HDD)
Carson	138	2992	0.0269 (0.2895)	NA
	139	2492	0.0336 (0.3616)	37.67 (427.65)
Hood	350	32016	0.0508 (0.5466)	33.4 (379.2)
	352	4617	0.0328 (0.3530)	24.6 (279.3)
			Avg. = 0.036 (0.387)	31.9 (362.1)

use of welders, winches, and other power tools, and the necessity for large, high bay doors. While the data presented are relatively uniform, the maintenance consumer group may have large fluctuations depending on the type of maintenance activities being performed. Figures 20 and 21 show typical monthly and daily profiles of energy usage.

Medical/Dental

Table 9 gives the data for medical/dental facilities. The data shown vary widely, with a factor of six difference between the largest and the smallest electrical usage. Here again the difference in usage patterns between building types appears to be the most important factor. Figures 22 through 25 show typical daily and monthly energy use profiles.

Community Support

Data for community support facilities are given in Table 10. The wide variation in the data clearly indicates that this consumer grouping may not be valid for comparisons with other groupings because of the large variations in building types within the group. For example, data point 149 is a commissary, data point 375 is a field house, and data point 239 is a post theater; all have widely different energy usages. Within building types the data are consistent. For example, data points 219 and 118, which are both officers' clubs, have similar usages. Figures 26 through 29 show typical daily and monthly energy use profiles for selected buildings from this consumer group.

Table 9

Energy Consumption Data—Medical/Dental Buildings

Fort	Data Point	Bldg. No.	Electrical Consumption kWh/sq ft/day (kWh/m²/day)	Heating Fuel Consumption, Btu/sq ft/HDD (kJ/m²/HDD)
Carson	147	1007	0.0139 (0.1496)	20.21 (229.44)
Belvoir	233	1009	0.0271 (0.2917)	NA
Hood	359	31002	0.0273 (0.2939)	29.3 (332.63)
	360	330	0.0864 (0.9300)	40.2 (456.4)
			Avg. = 0.0387 (0.4166)	29.9 (339.4)

Comparisons by Consumer Group

Table 11 summarizes average consumption for each consumer group. Figures 30 and 31 show the relative electrical and heating fuel usage by consumer group. As the figures show, the family and troop housing facilities are the smaller electrical users while administration, maintenance, medical/dental, and community support facilities are the larger electrical users. In terms of heating energy usage, the newer barracks are the smallest users, while the medical/dental and maintenance facilities are the largest users.

4 CONCLUSIONS

Since the data, curves, and analysis presented in this report are based on only a small amount of data, indicated trends and conclusions must be viewed as preliminary. They represent only a basis for further analysis; the data presented in this report do not constitute a sufficient sample for immediate application in the field. With those considerations in mind, the following preliminary conclusions and trends

Table 10

Energy Consumption Data—Community Support Facilities

Fort	Data Point	Bldg. No.	Electrical Consumption kWh/sq ft/day (kWh/m²/day)	Heating Fuel Consumption, Btu/sq ft/HDD (kJ/m²/HDD)
Carson	118	7300 (Officers' Club)	0.0677 (0.7287)	2.96 (33.61) (Officers' Club)
	149	3572 (Commissary Annex)	0.201 (2.164)	21.96 (249.38) (Commissary Annex)
Belvoir	219	20 (Officers' Club)	0.0555 (0.5974)	NA (Officers' Club)
	239	2120 (Theater)	0.0038 (0.0409)	26.46 (300.49) (Theater)
Hood	363	12018 (Gymnasium)	0.0245 (0.2637)	28.12 (319.34) (Gymnasium)
	364	37017 (Gymnasium)	0.0181 (0.1948)	NA (Gymnasium)
	375	23001 (Field House)	0.0370 (0.3983)	14.86 (168.75) (Field House)

Table 11

Summary of Average Consumption by Consumer Group

Consumer Group	Electrical Consumption kWh/sq ft/day (kWh/m²/day)	Standard Deviation	Heating Fuel Consumption Btu/sq ft/HDD (kJ/m²/HDD)	Standard Deviation
Maintenance	.0360 (0.3875)	.0103	31.86 (361.81)	6.66
Medical/Dental	.0387 (0.4166)	.0324	29.90 (339.55)	10.0
Administration	.0287 (0.3089)	.0100	20.17 (229.06)	7.62
Barracks (built prior to 1966)	.0089 (0.0958)	.0025	15.83 (179.77)	8.3
Barrack (built since 1966)	.0170 (0.1830)	.0046	7.83 (88.92)	7.54
Family Housing	.0155 (0.1668)	.0031	18.71 (212.48)	5.18
Community Facilities	.0582 (0.6265)	.0666	18.87 (214.29)	10.27

were drawn based on the analysis presented in this report:

1. The preliminary analysis of the data shows that family housing, troop housing, and administration buildings are valid as energy consumer groupings. The wide variation in energy use for medical/dental and community support buildings and the potential variation for maintenance buildings indicate that further analysis is required to categorize these buildings into consistent energy consumer groups.

2. Energy consumption differences of up to 40 percent are indicated for buildings which are the same size and identical in construction (family housing data points 319 and 320 and barracks data points 136 and 137). Additional analysis of these buildings is required to determine whether these differences are inherent in the structures or are caused by life style variances.

3. A comparison between energy use and building construction may be valid. Additional data and analysis will be required to verify these trends.

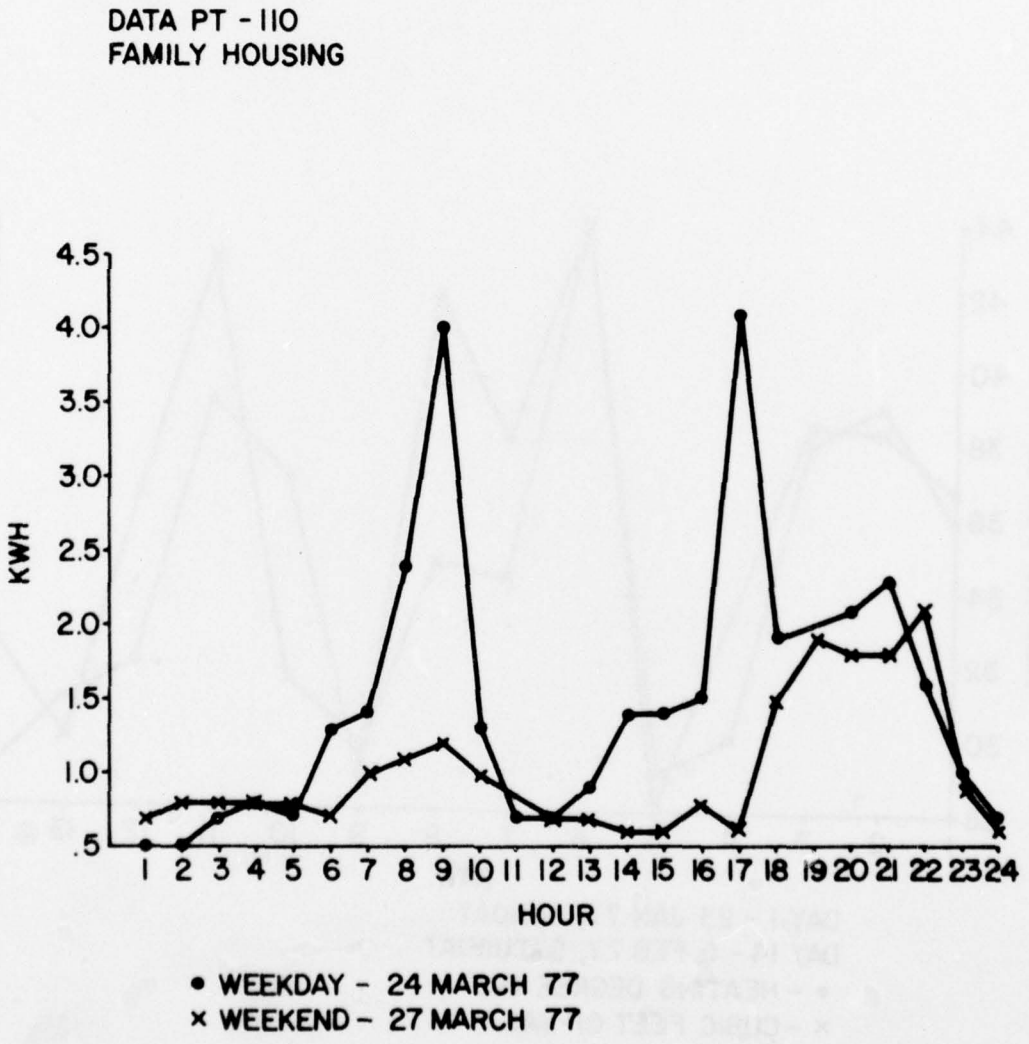


Figure 1. Daily profiles for electrical usage in a family housing unit at Fort Carson.

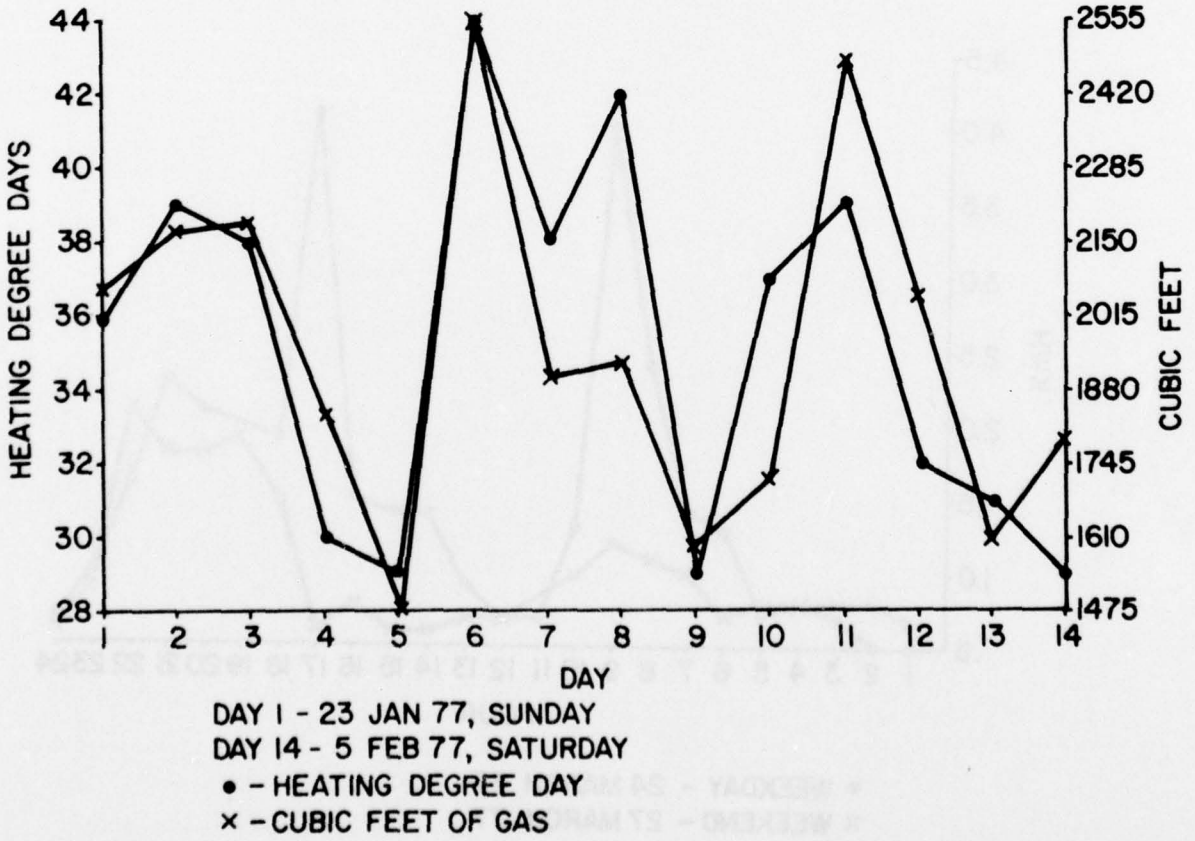


Figure 2. Heating consumption vs. heating degree days for a typical family housing unit located at Fort Carson. SI conversion factor: 1 cu ft = 0.0283 m^3.

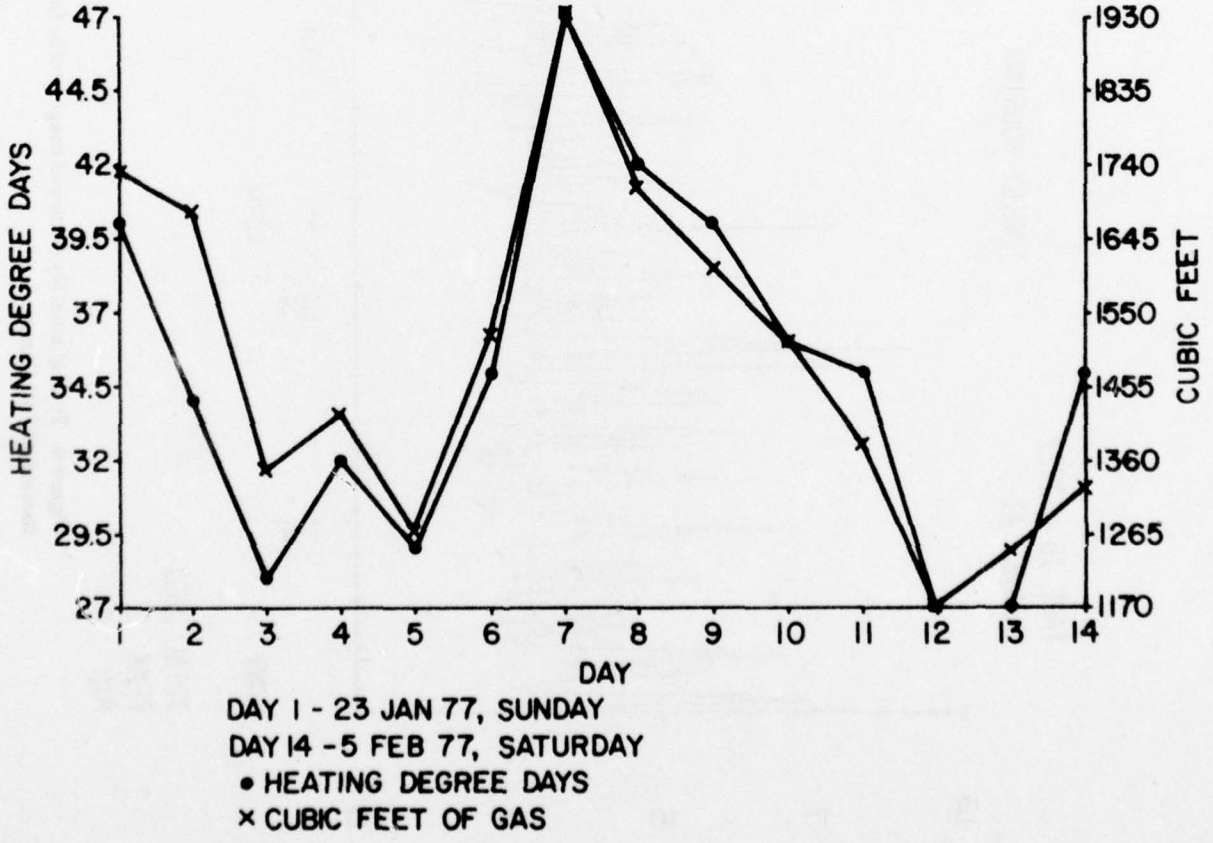


Figure 3. Heating consumption vs. heating degree days for a typical family housing unit located at Fort Belvoir. SI conversion factor: 1 cu ft = 0.0283 m^3.

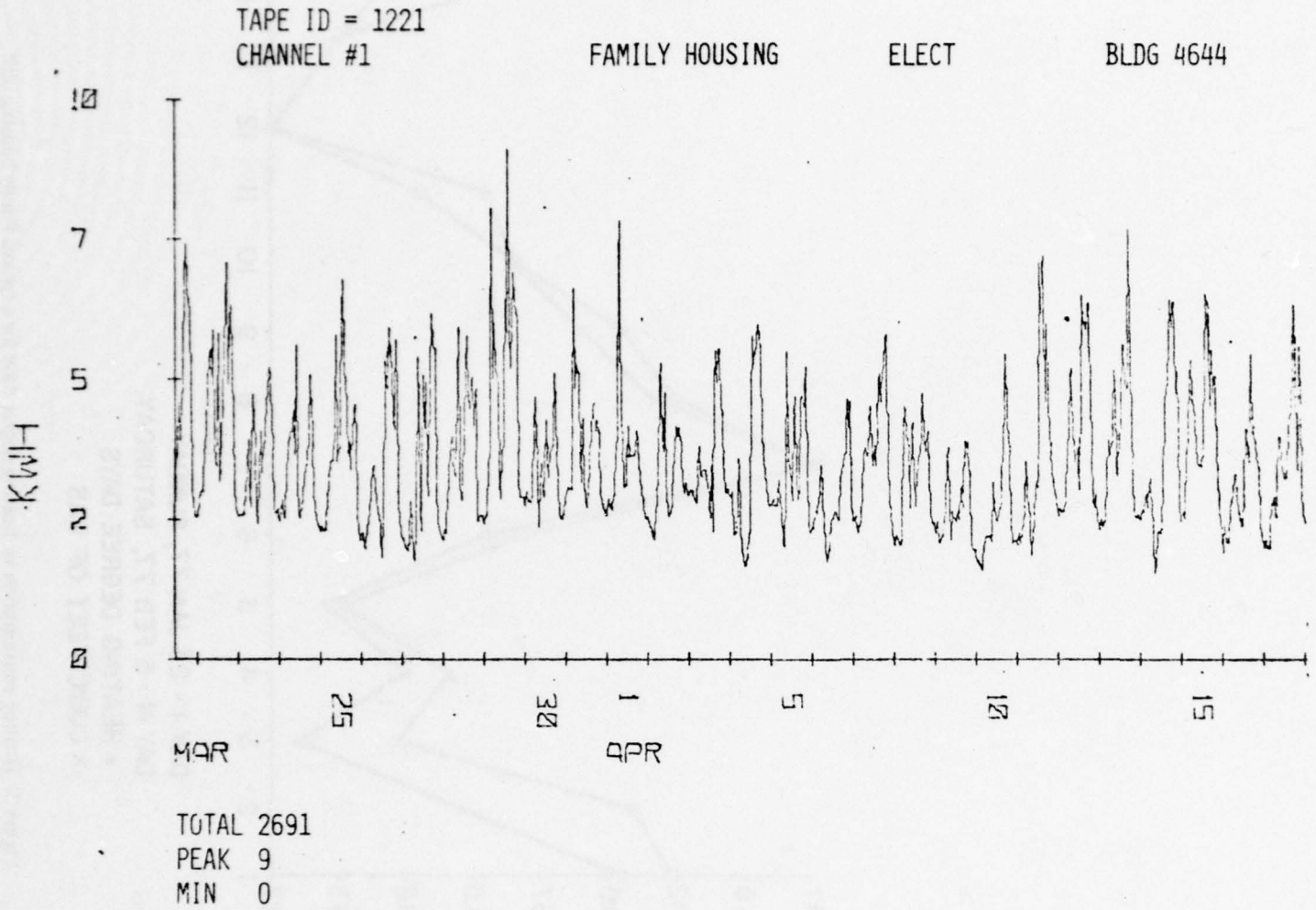


Figure 4. Typical monthly electrical usage profile for multi-family housing located at Fort Carson.

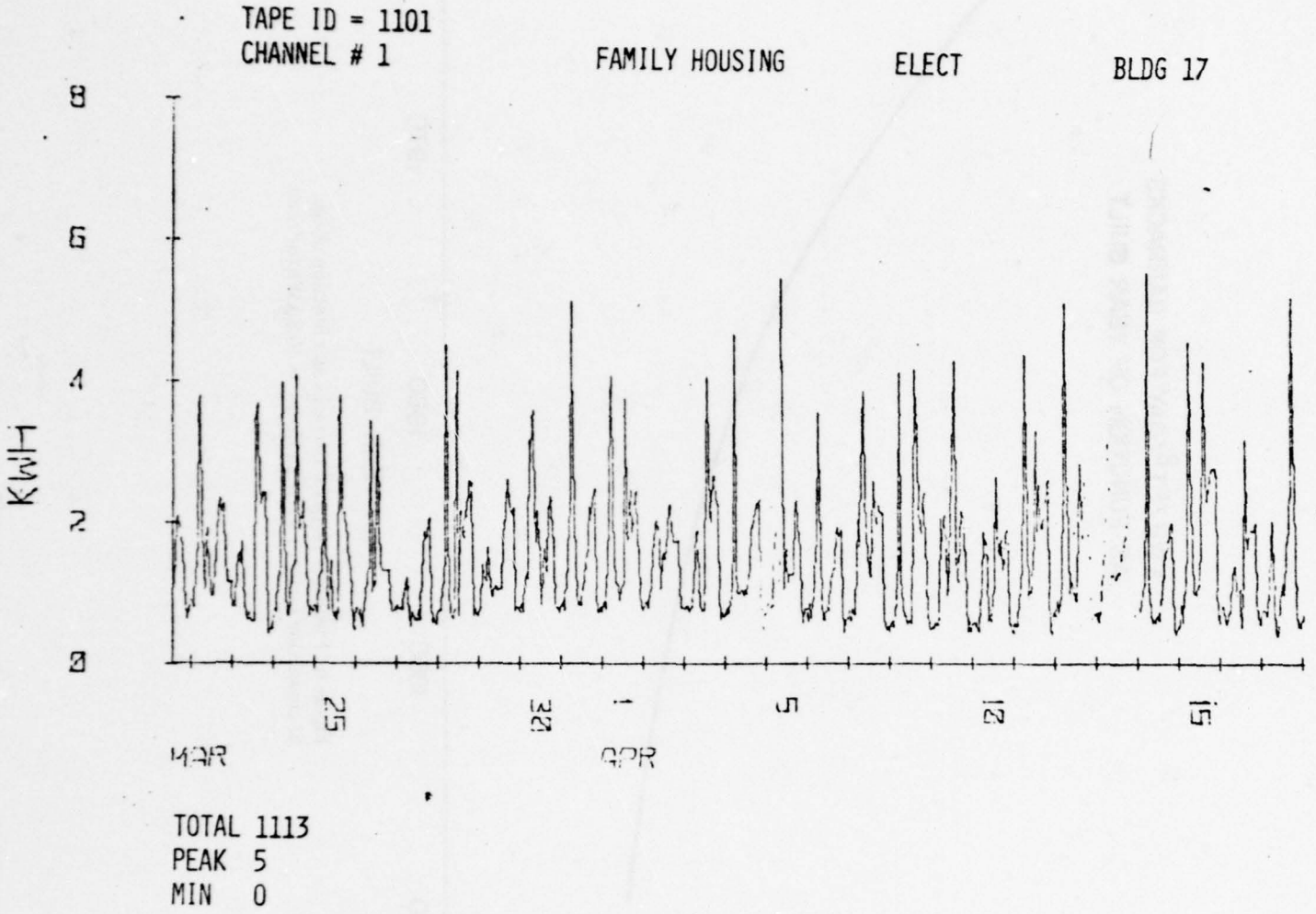


Figure 5. Typical monthly electrical usage profile for single-family housing located at Fort Carson.

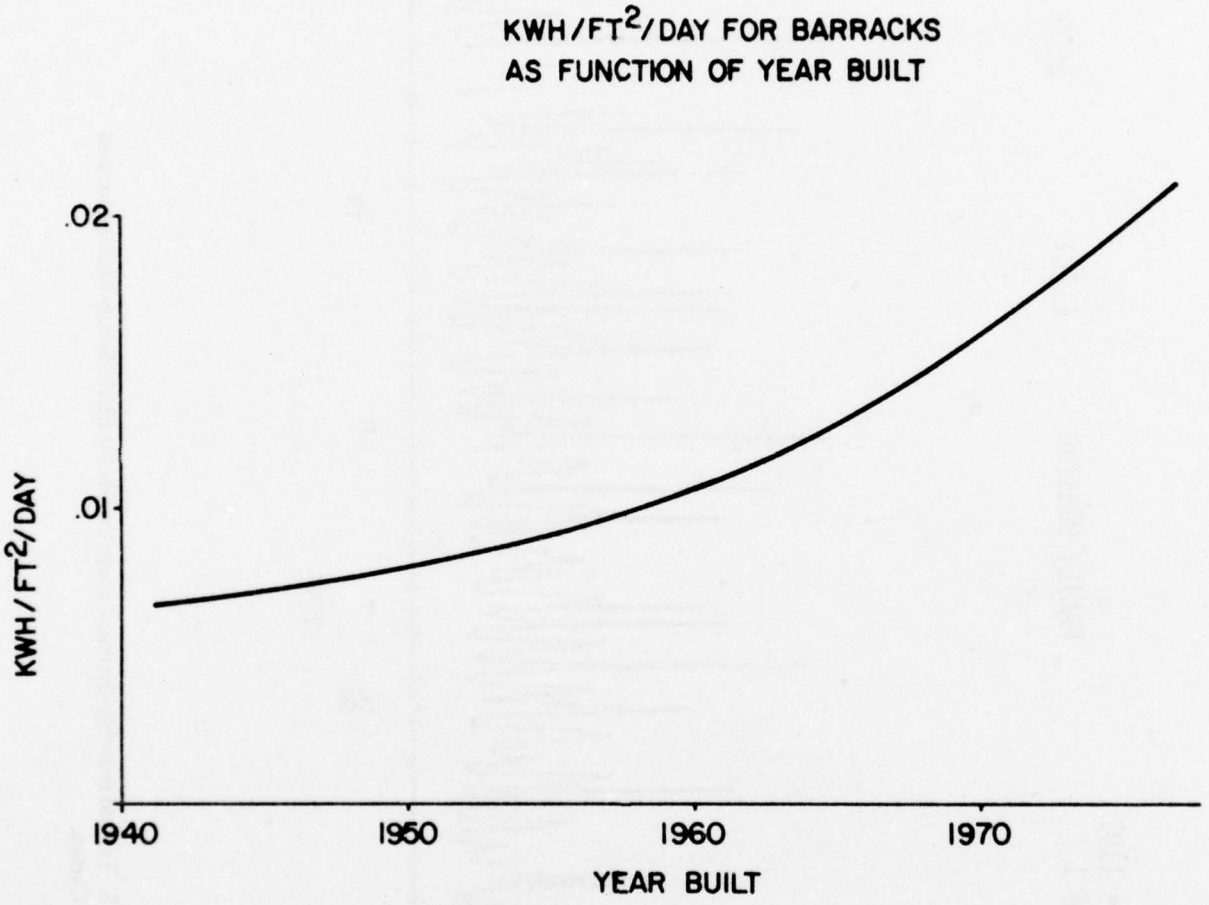


Figure 6. Electrical usage for barracks as a function of age.
SI conversion factor: 1 kWh/sq ft/day = 10.8 kWh/m²/day.

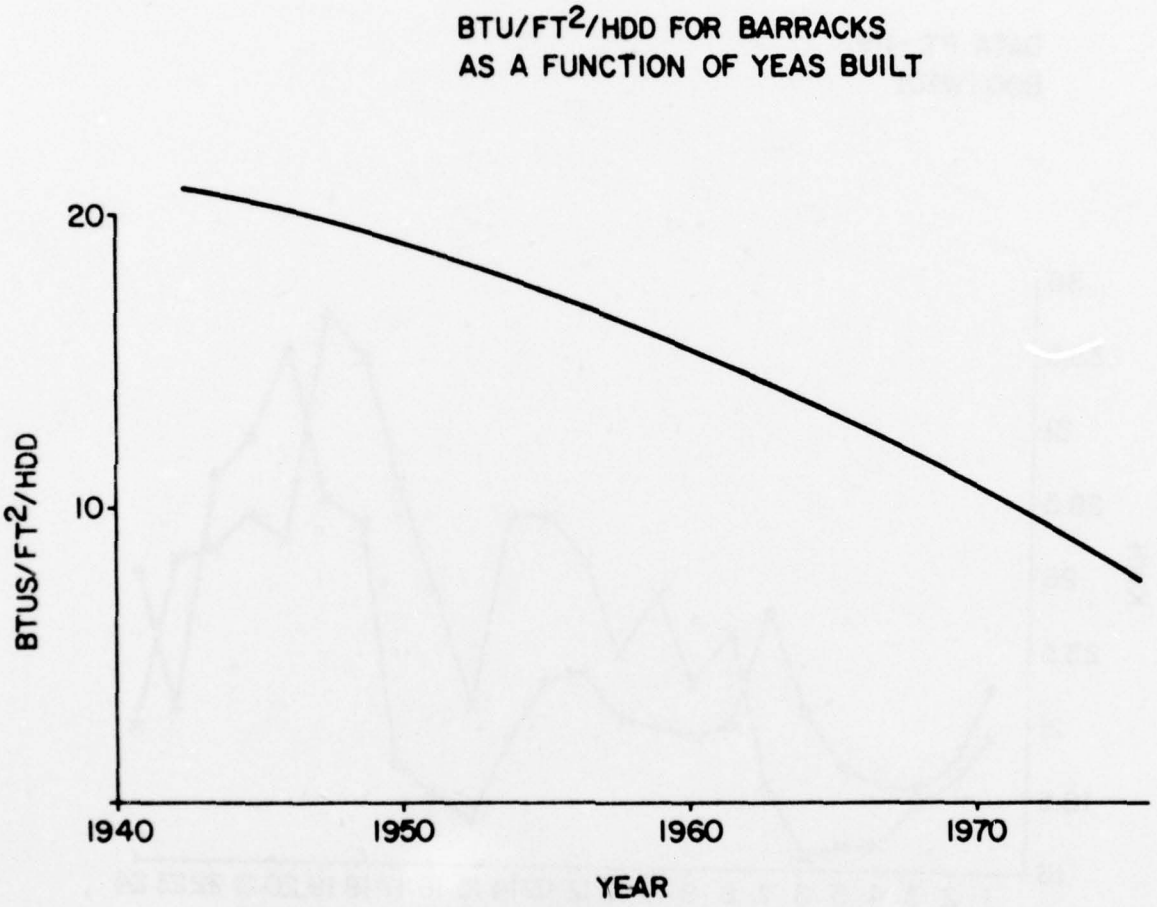


Figure 7. Gas/oil usage for barracks as a function of age. SI conversion factor: 1 Btu/sq ft/HDD = 11.4 kJ/m²/HDD.

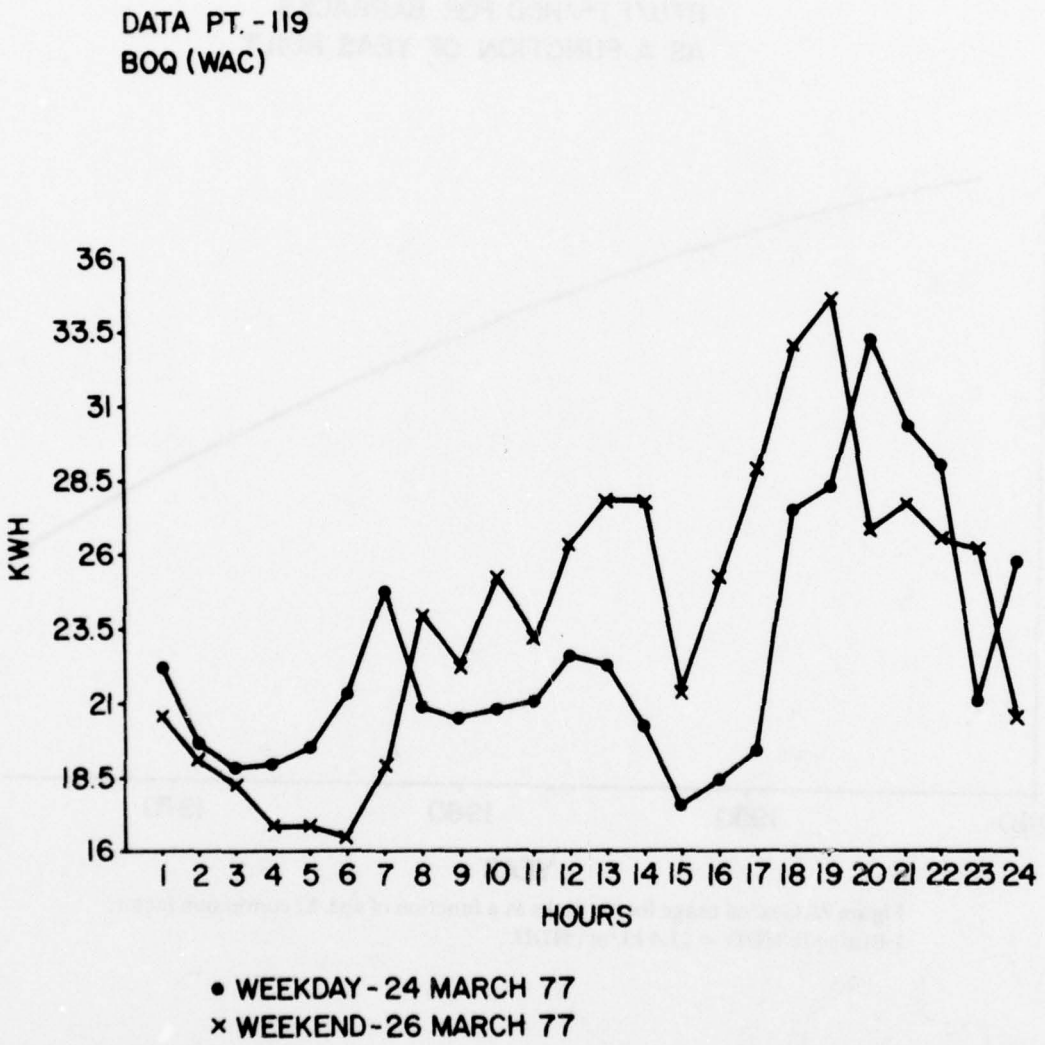


Figure 8. Daily profiles for electrical usage in a Bachelor Officers' Quarters (BOQ) at Fort Carson.

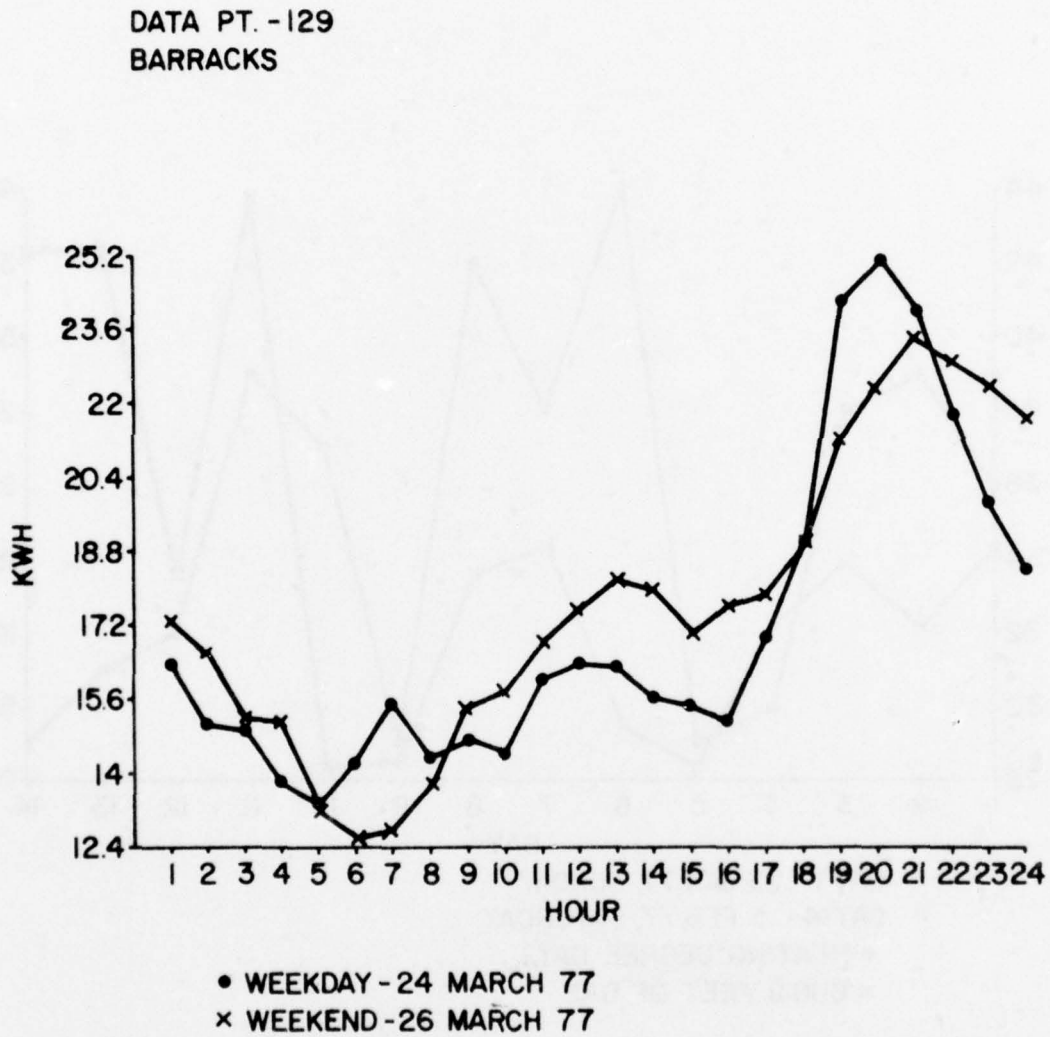


Figure 9. Daily profiles for electrical usage in a barracks building at Fort Carson.

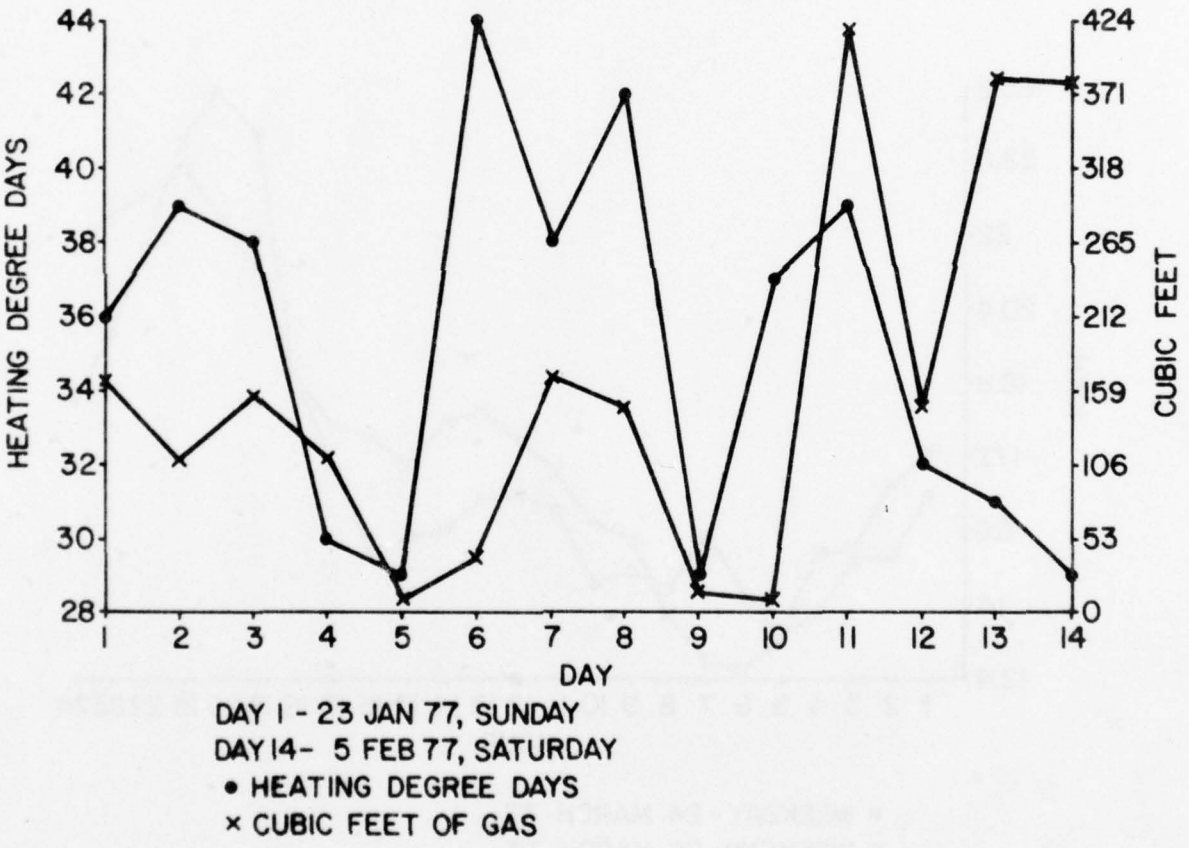


Figure 10. Heating consumption vs. heating degree days for a typical barracks building at Fort Carson. SI conversion factor: 1 cu ft = 0.0283 m^3.

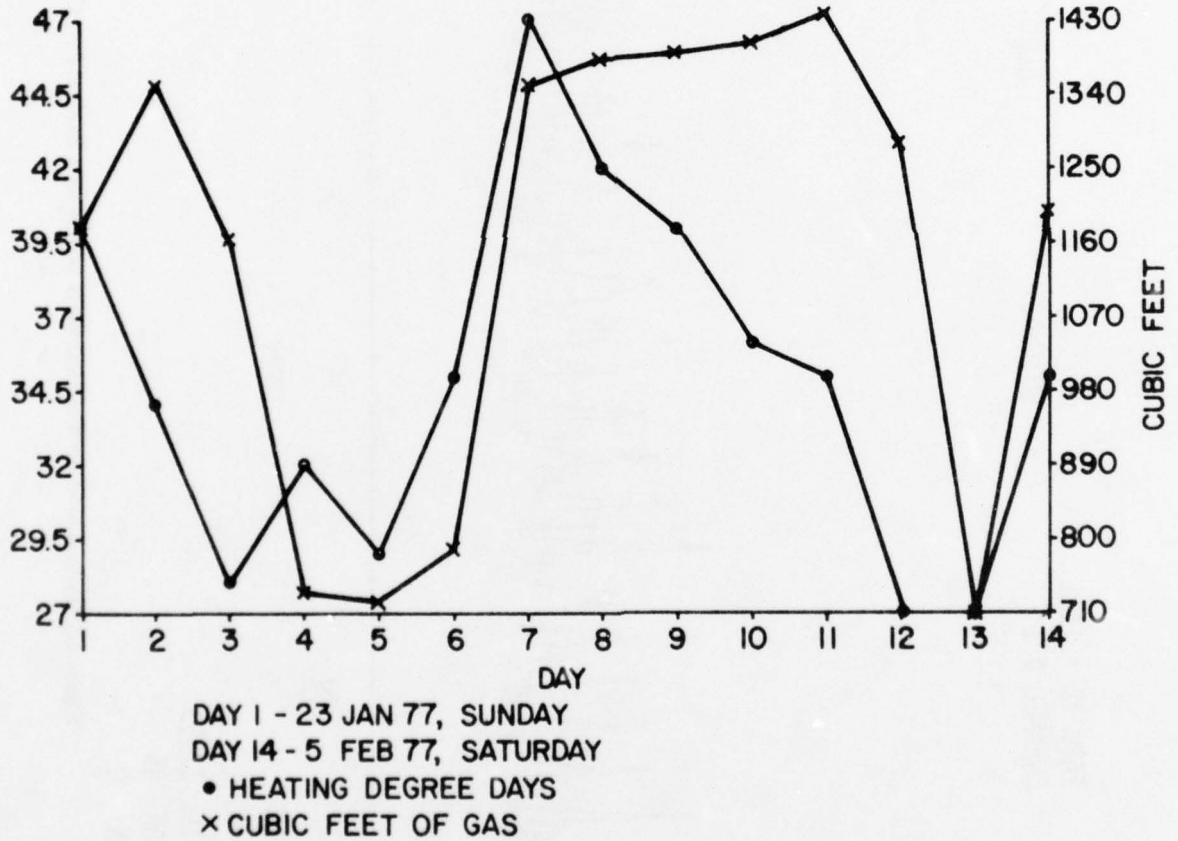


Figure 11. Heating consumption vs. heating degree days for a typical barracks building at Fort Belvoir. SI conversion factor: 1 cu ft = 0.0283 m^3.

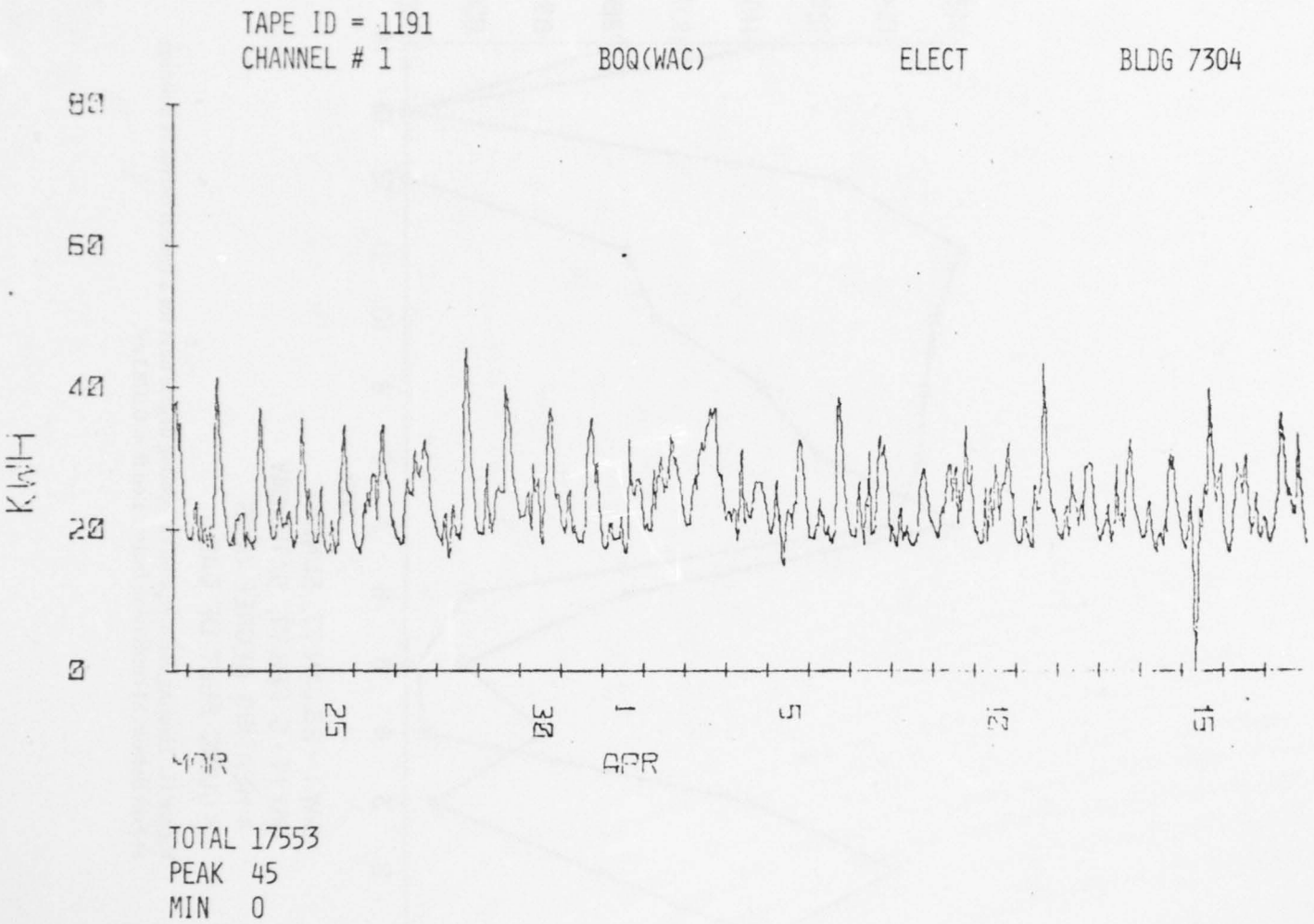


Figure 12. Typical monthly electrical usage profile for a BOQ at Fort Carson.

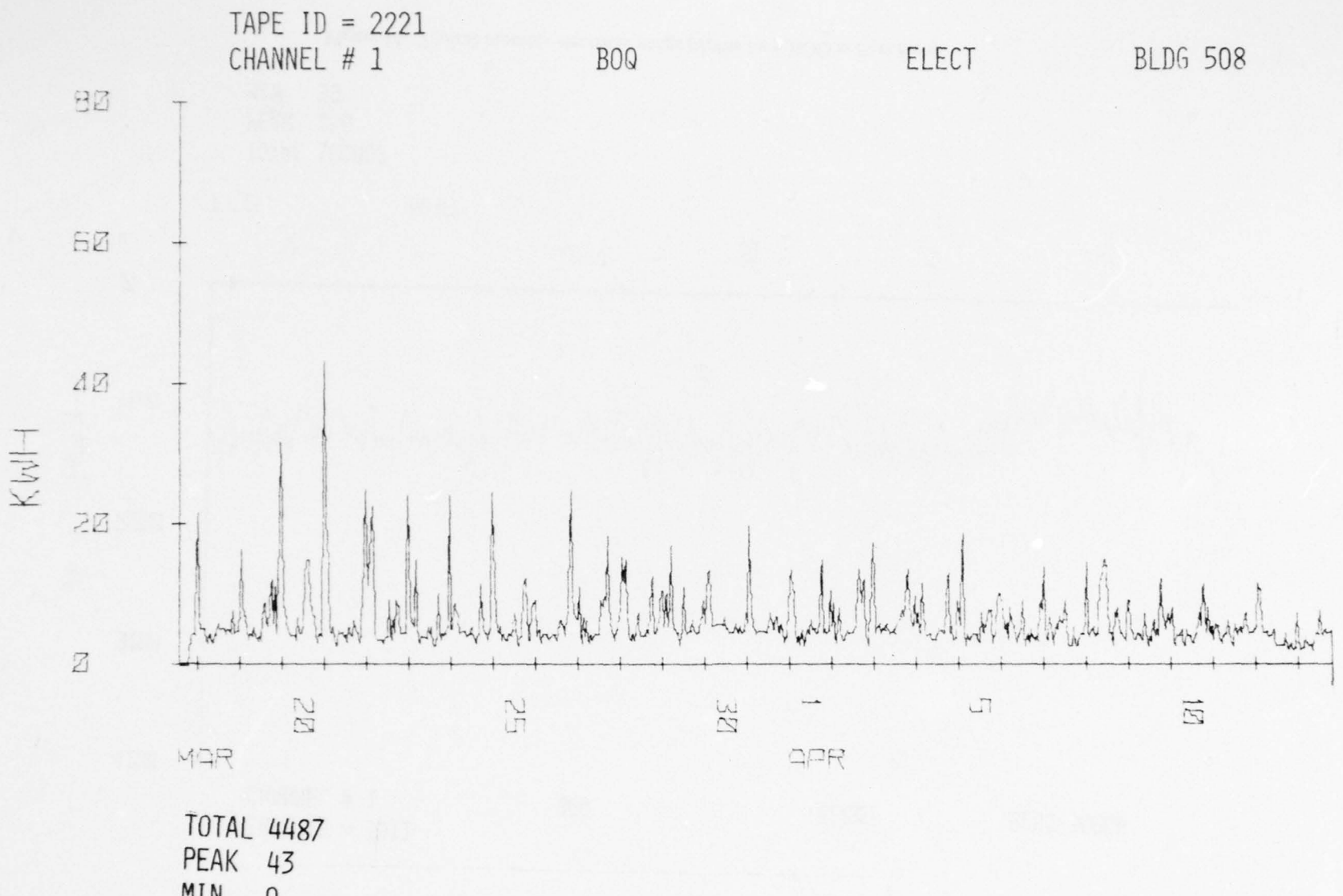


Figure 13. Typical monthly electrical usage profile for a BOQ at Fort Belvoir.

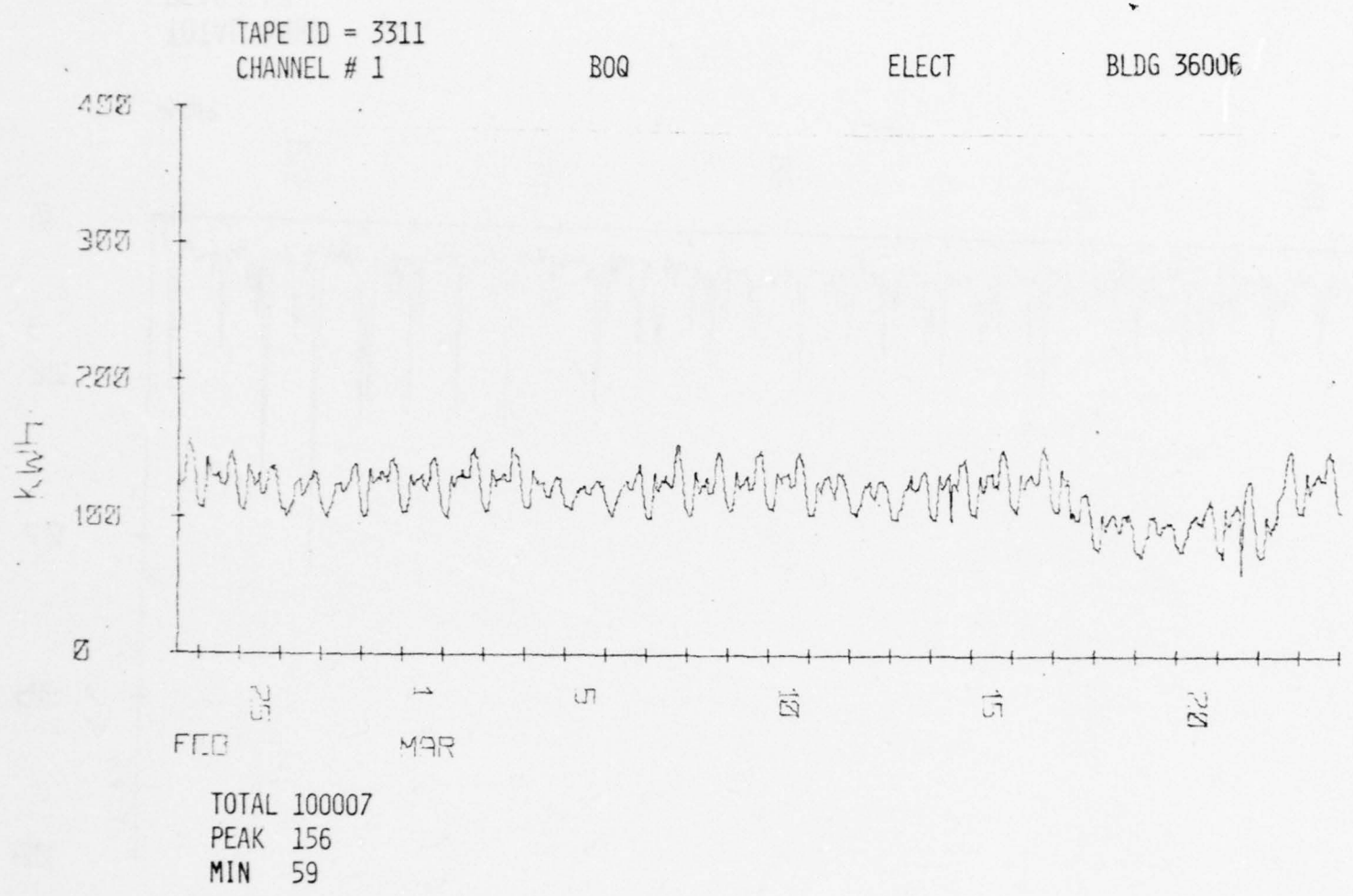


Figure 14. Typical monthly electrical usage profile for a BOQ at Fort Hood.

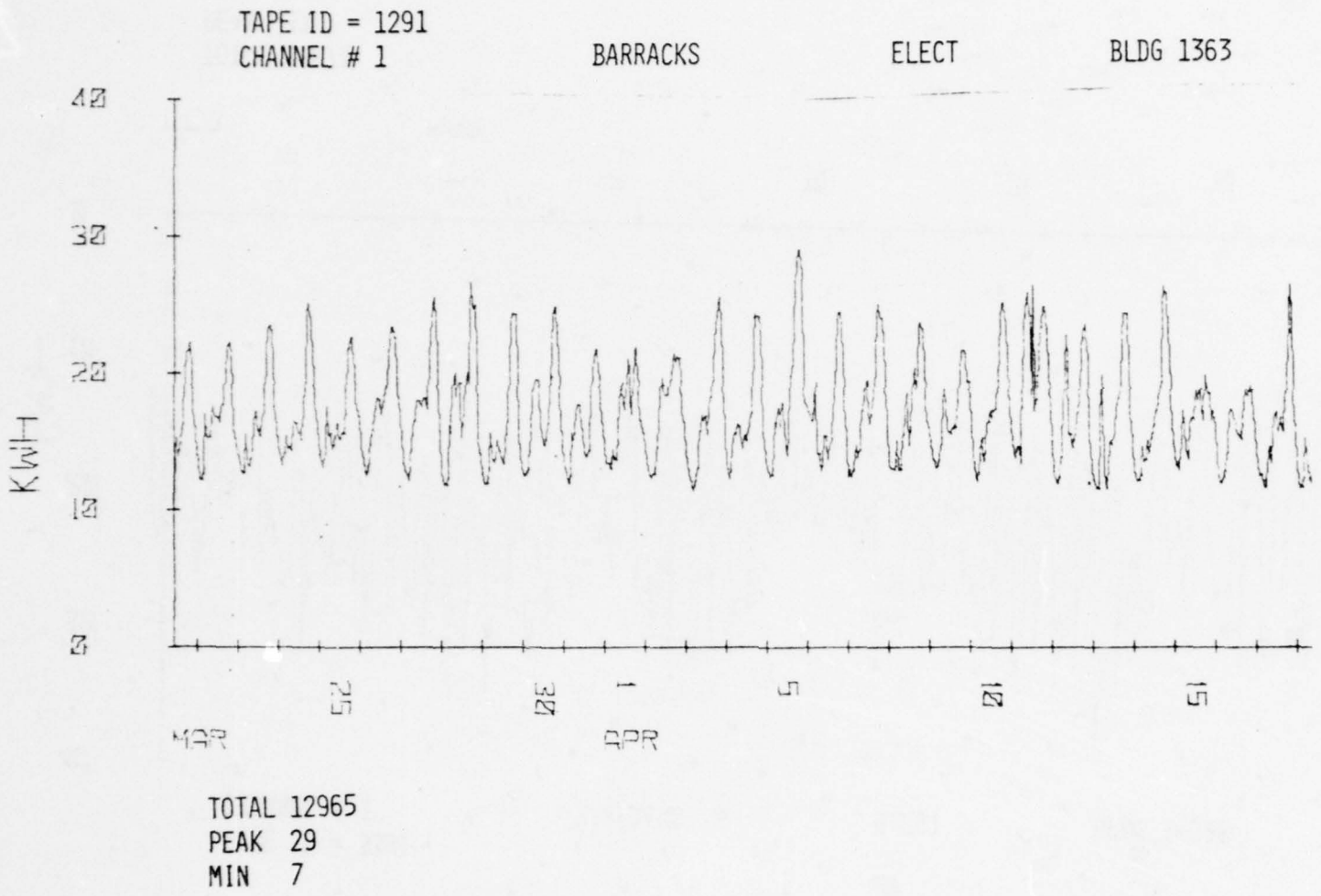


Figure 15. Typical monthly electrical usage profile for a Bachelor Enlisted Quarters (BEQ) at Fort Carson (65 percent actual size).

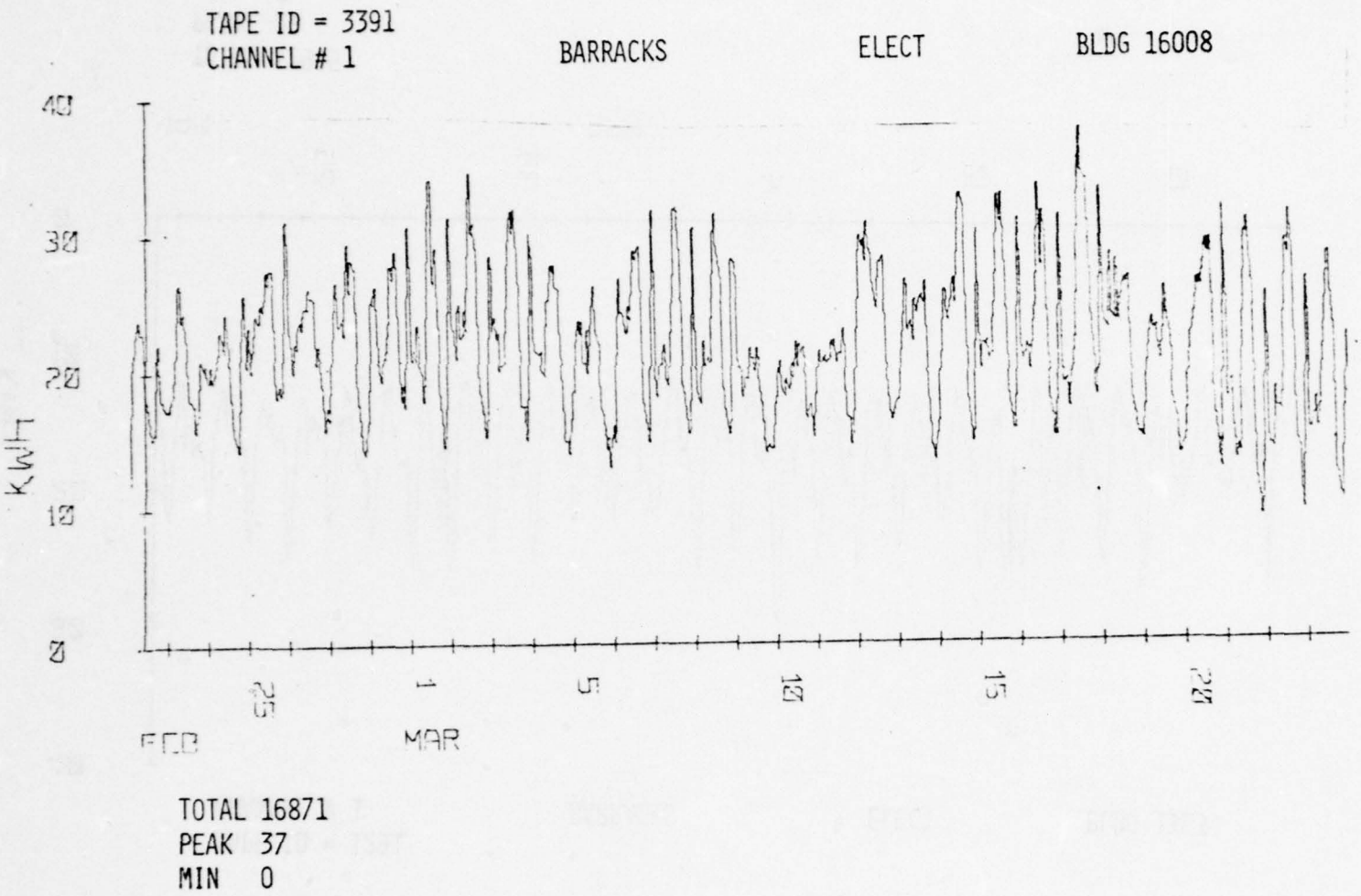


Figure 16. Typical monthly electrical usage profile for a BEQ at Fort Hood.

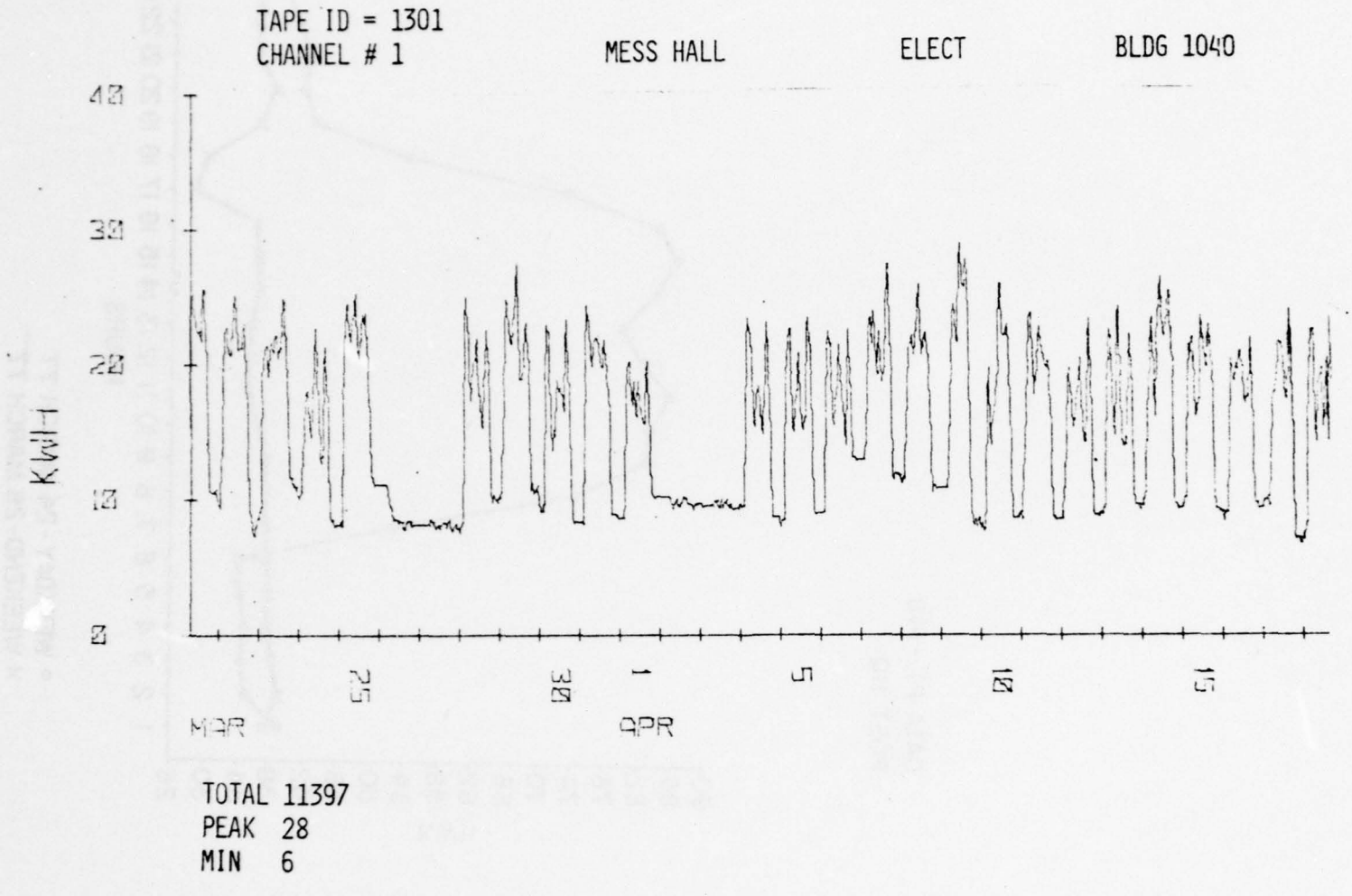


Figure 17. Typical monthly electrical usage profile for an enlisted dining facility at Fort Carson.

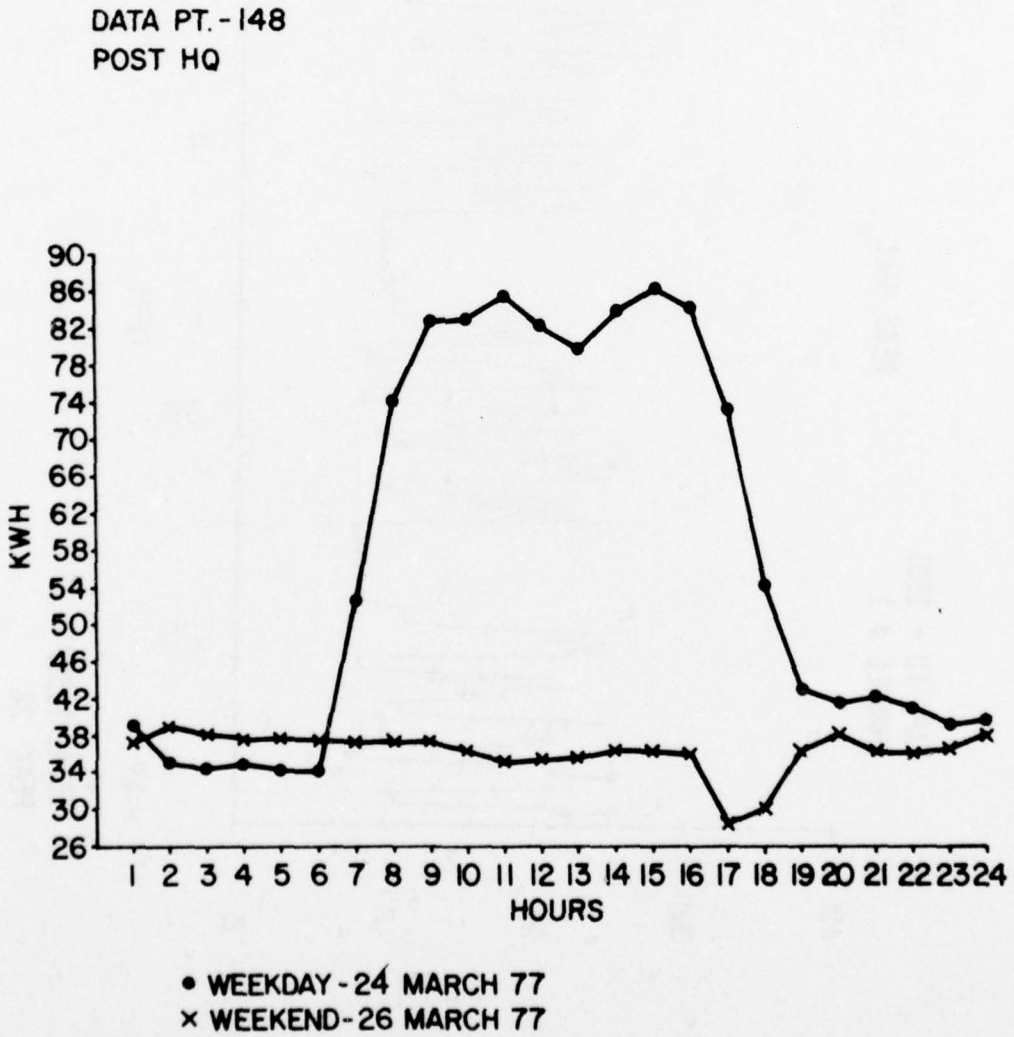


Figure 18. Daily profiles for electrical usage in an administration building at Fort Carson.

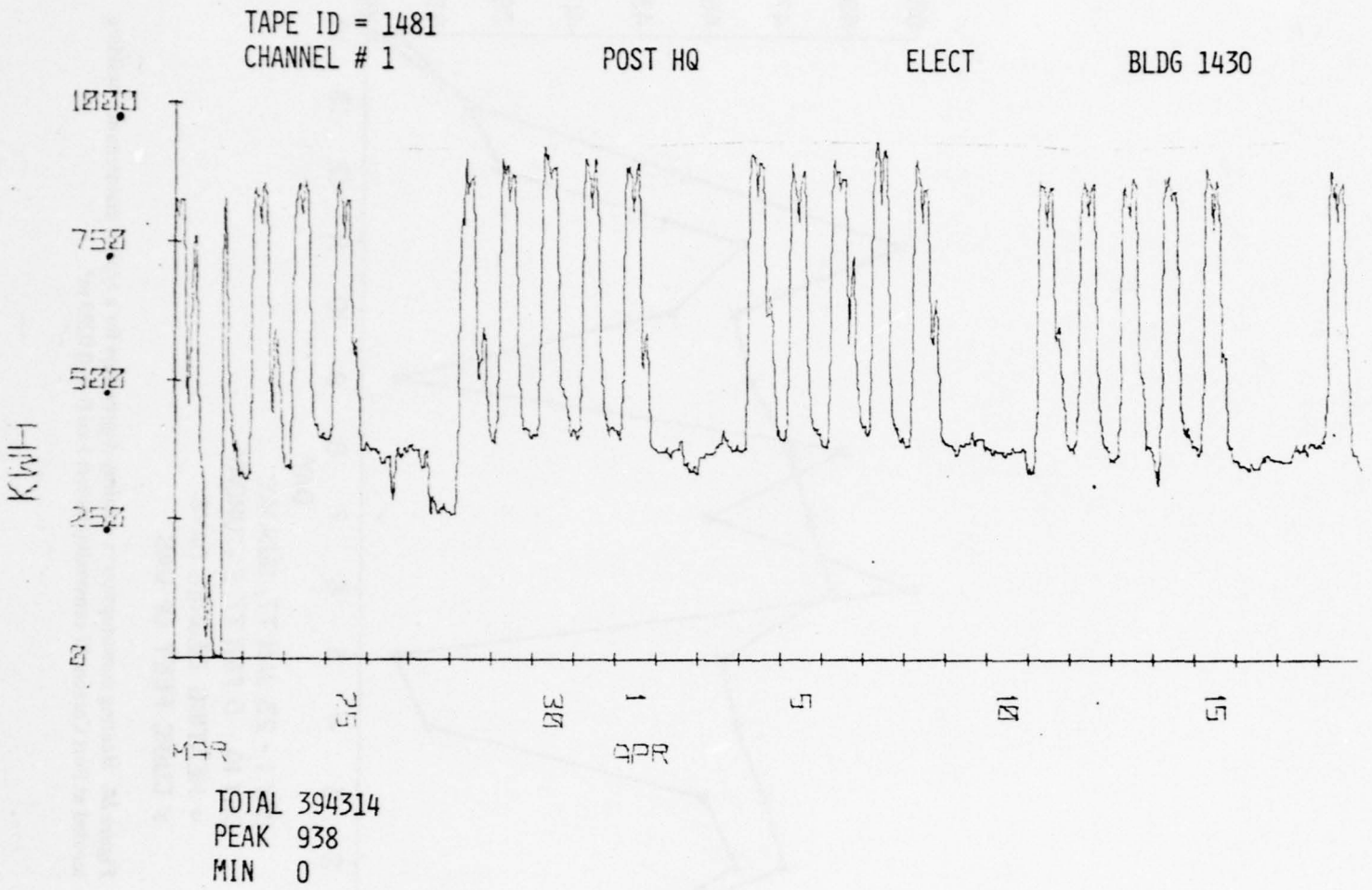


Figure 19. Typical monthly electrical usage profile for an administration building at Fort Carson.

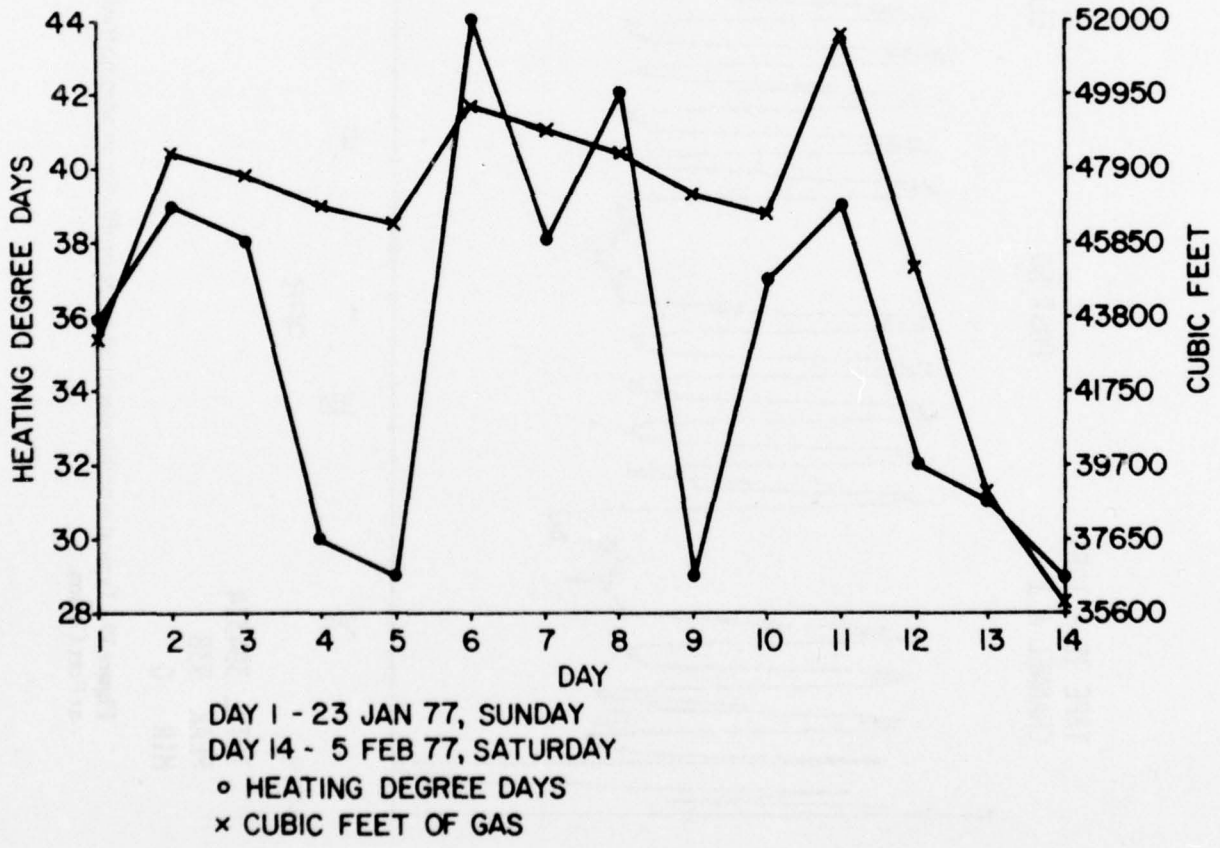


Figure 20. Heating consumption vs. heating degree days for a typical maintenance building located at Fort Carson. SI conversion factor: 1 cu ft = 0.0283 m^3.

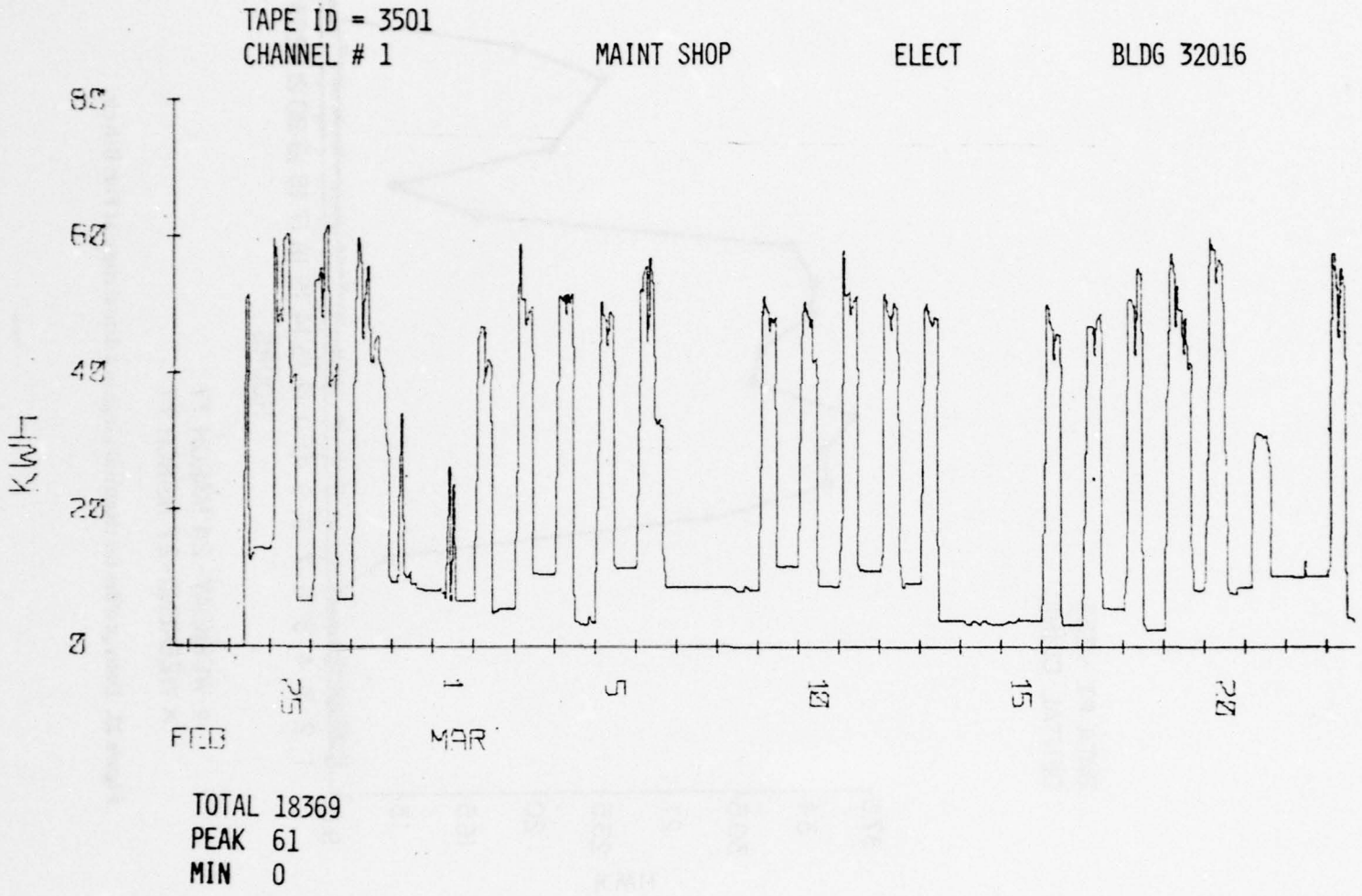


Figure 21. Typical monthly electrical usage profile for maintenance building at Fort Hood.

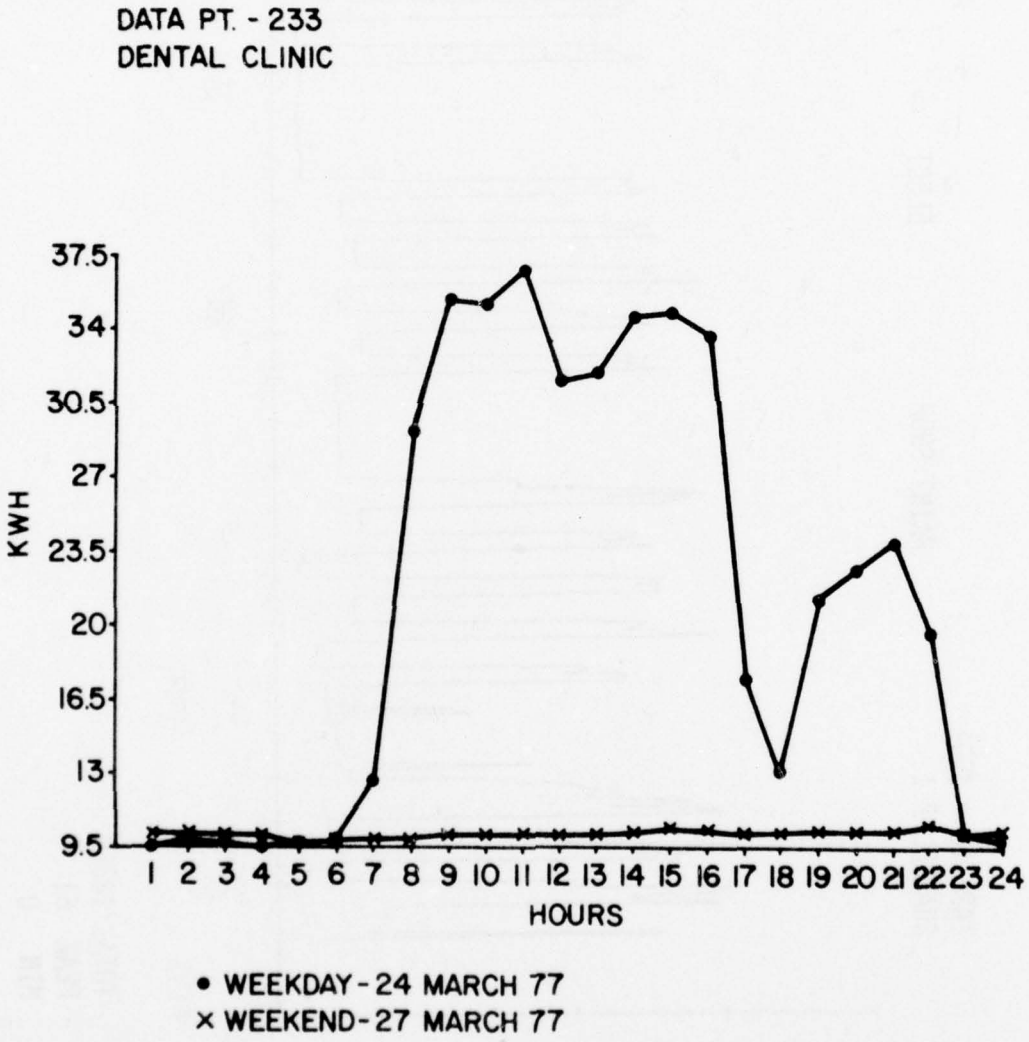


Figure 22. Daily profiles for electrical usage in a dental clinic at Fort Belvoir.

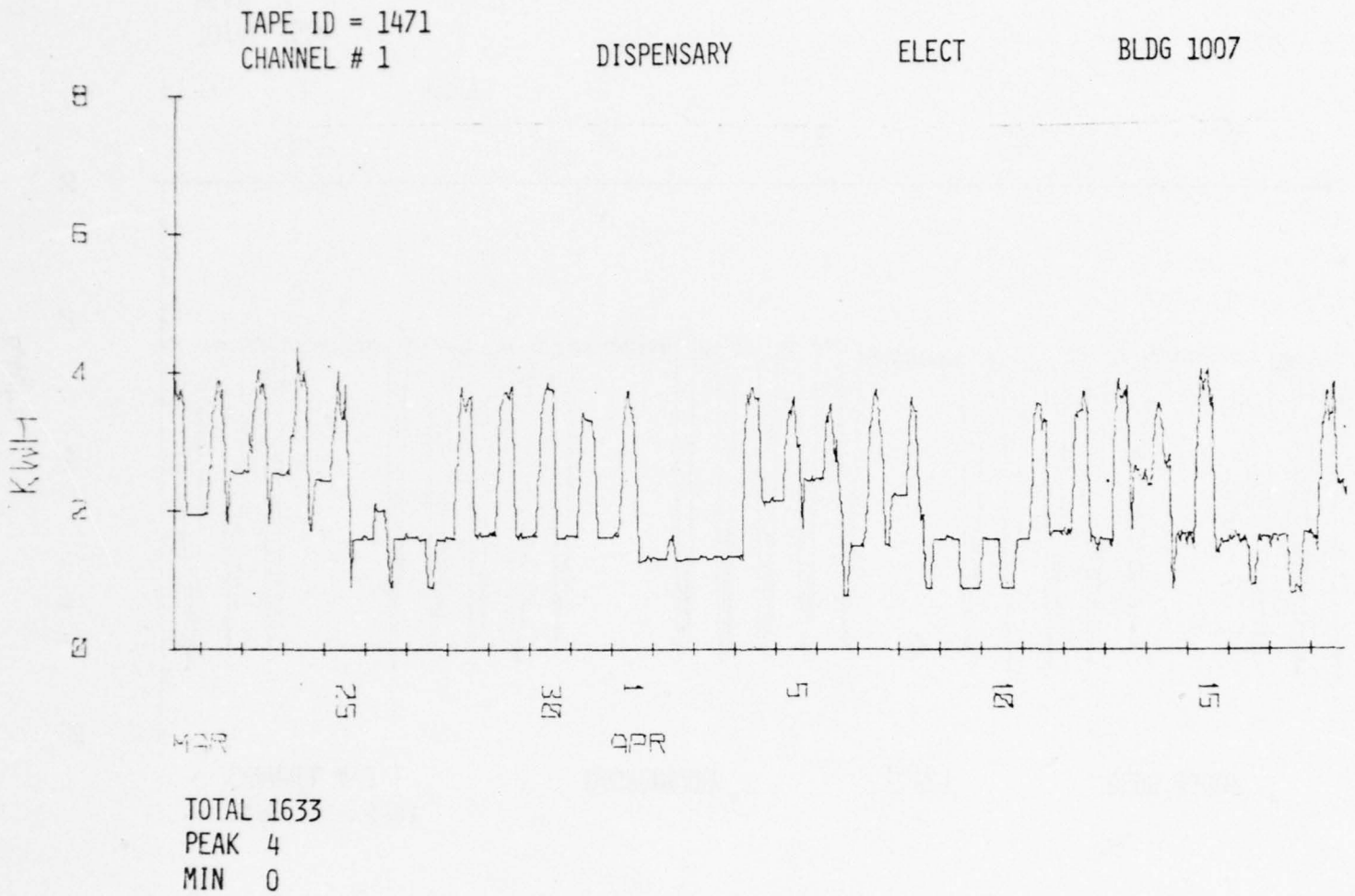


Figure 23. Typical monthly electrical usage profile for a dispensary at Fort Carson.

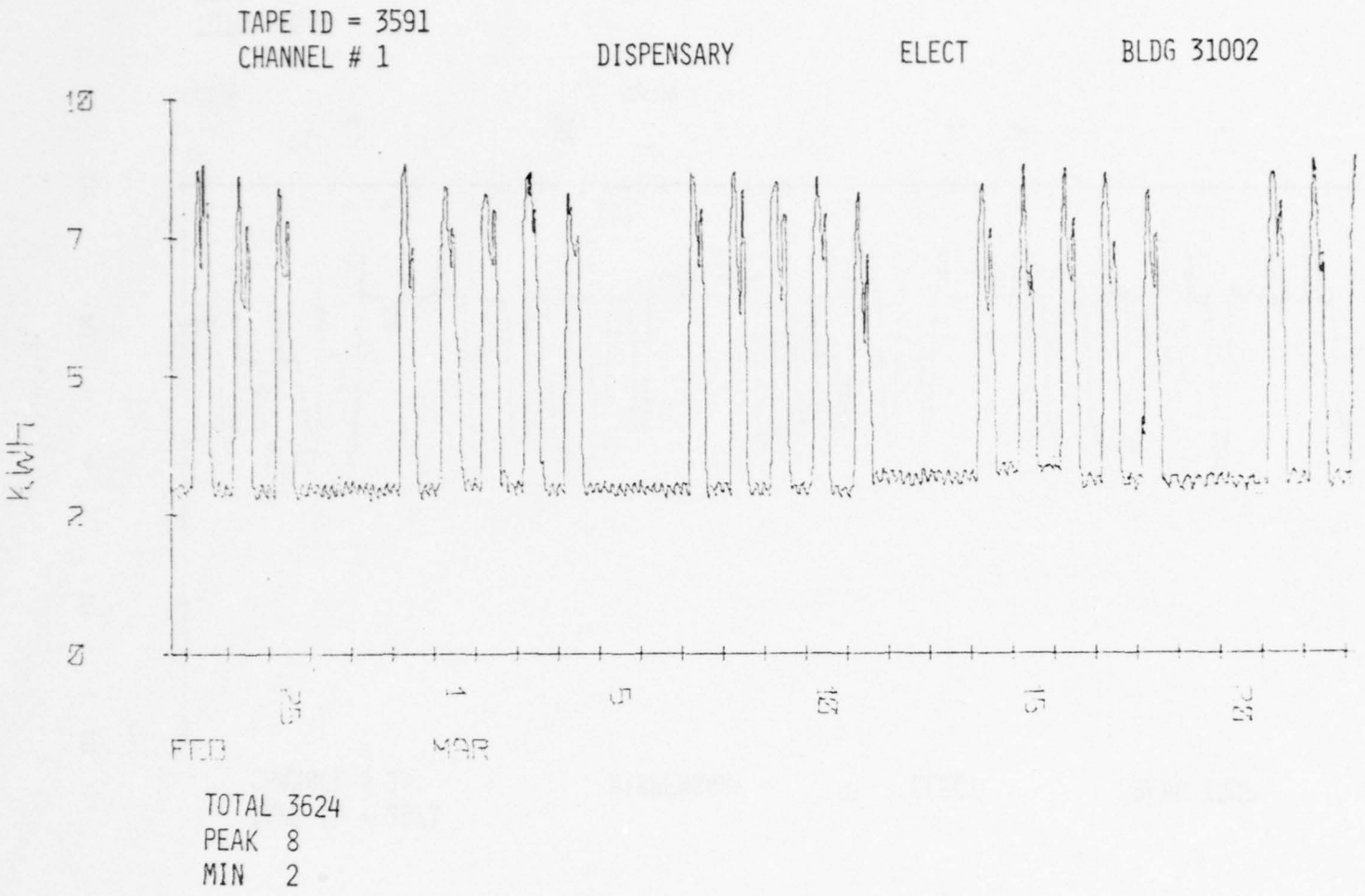


Figure 24. Typical monthly electrical usage profile for a dispensary at Fort Hood.

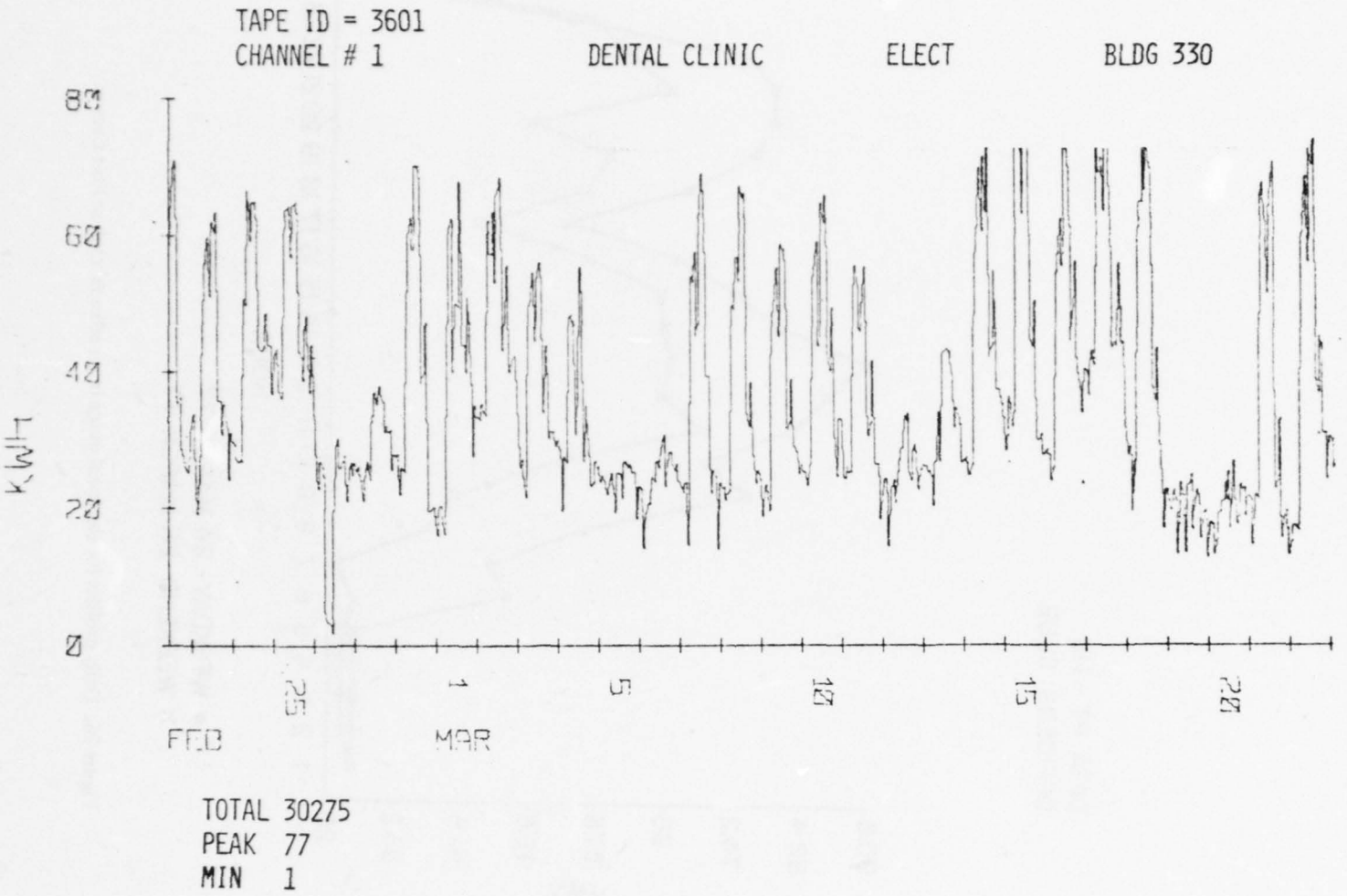


Figure 25. Typical monthly electrical usage profile for a dental clinic at Fort Carson.

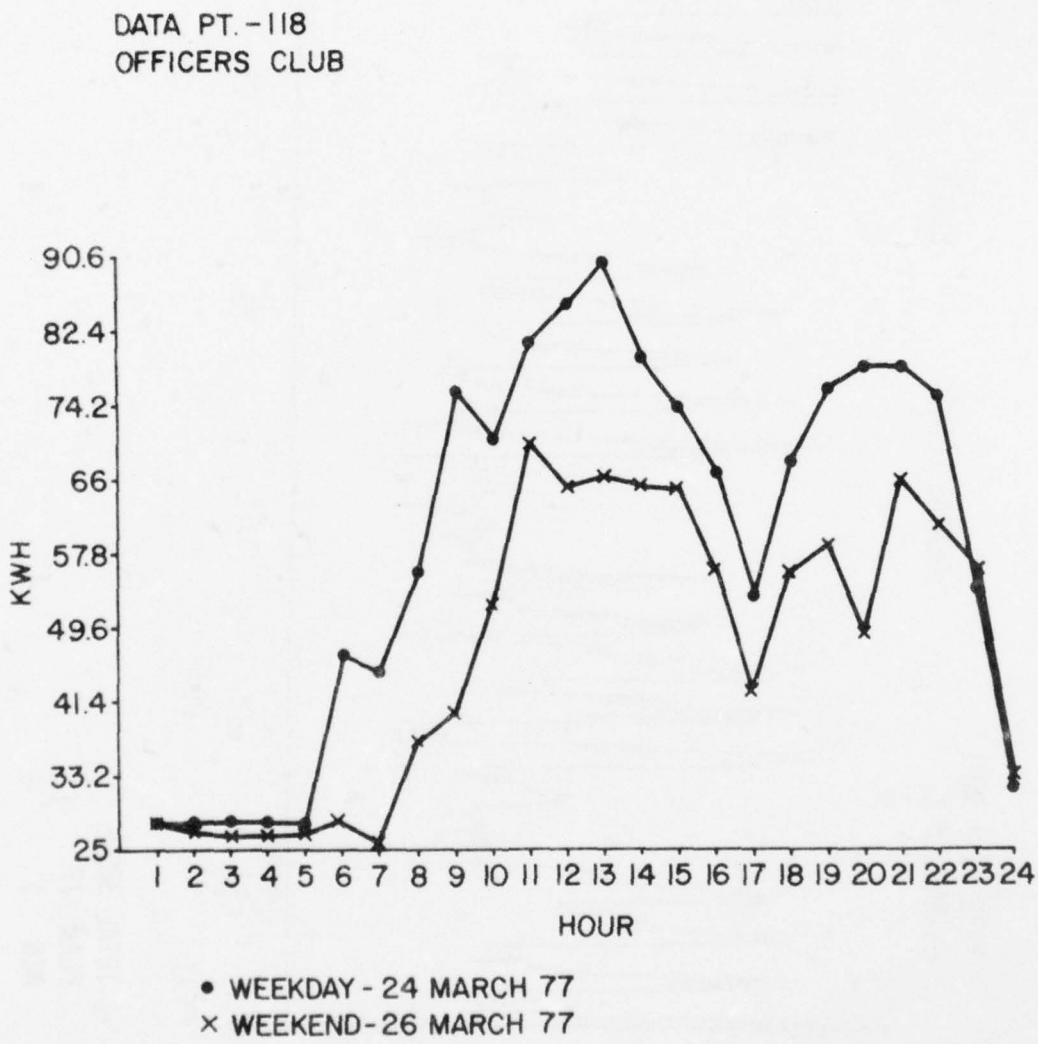


Figure 26. Daily profiles for electrical usage in an officers' club at Fort Carson.

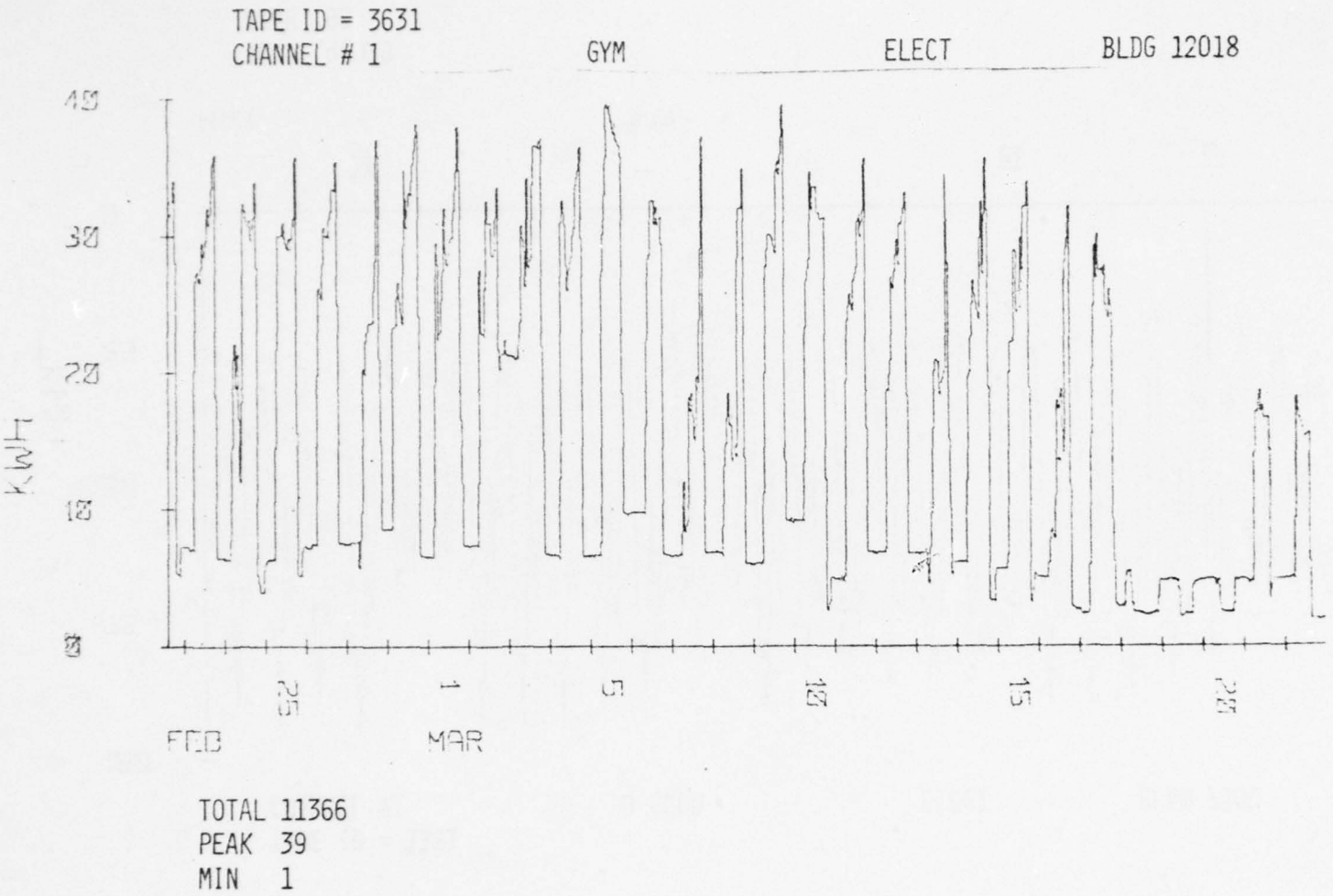


Figure 27. Typical monthly electrical usage profile for a gymnasium at Fort Hood.

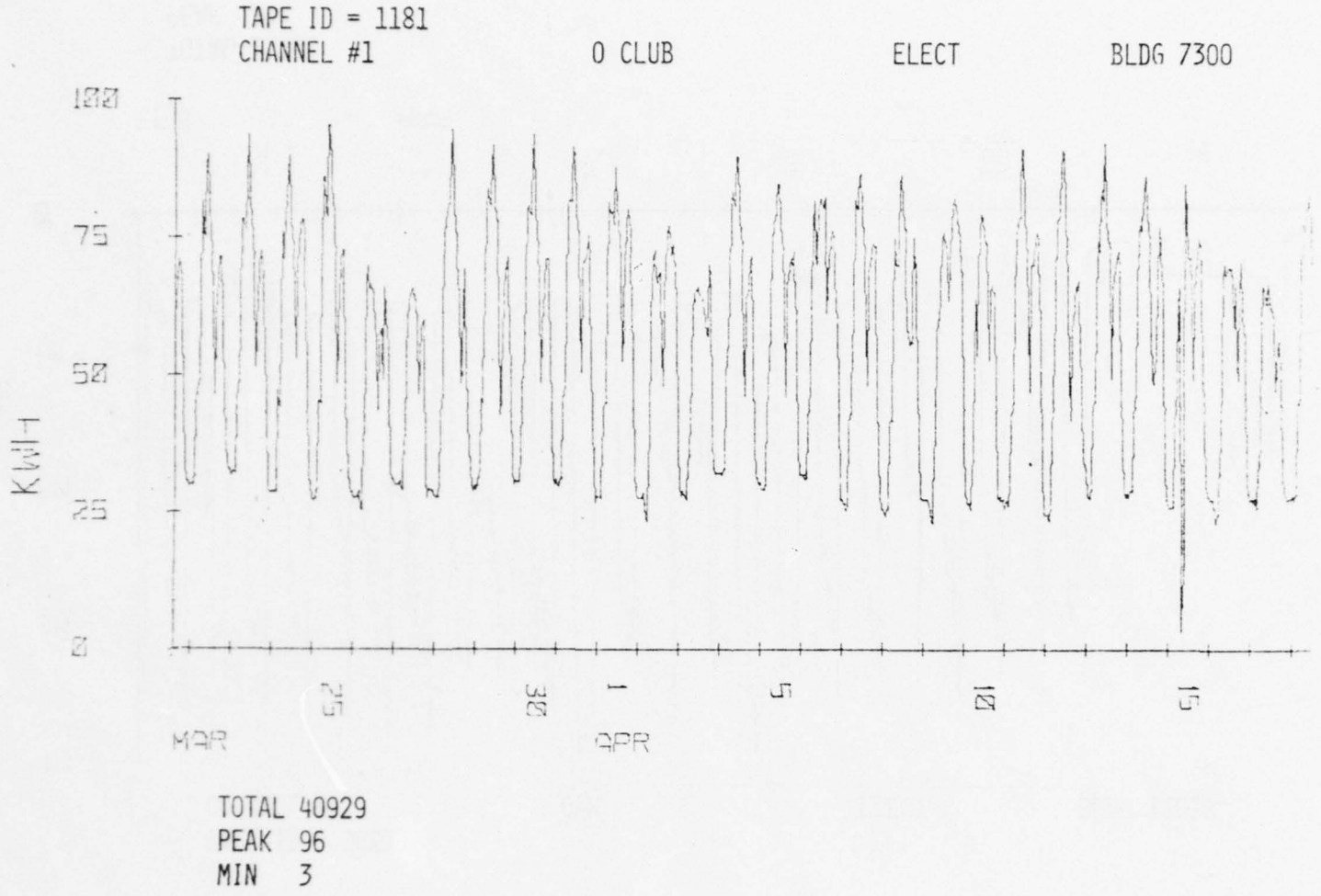


Figure 28. Typical monthly electrical usage profile for an officers' club at Fort Carson.

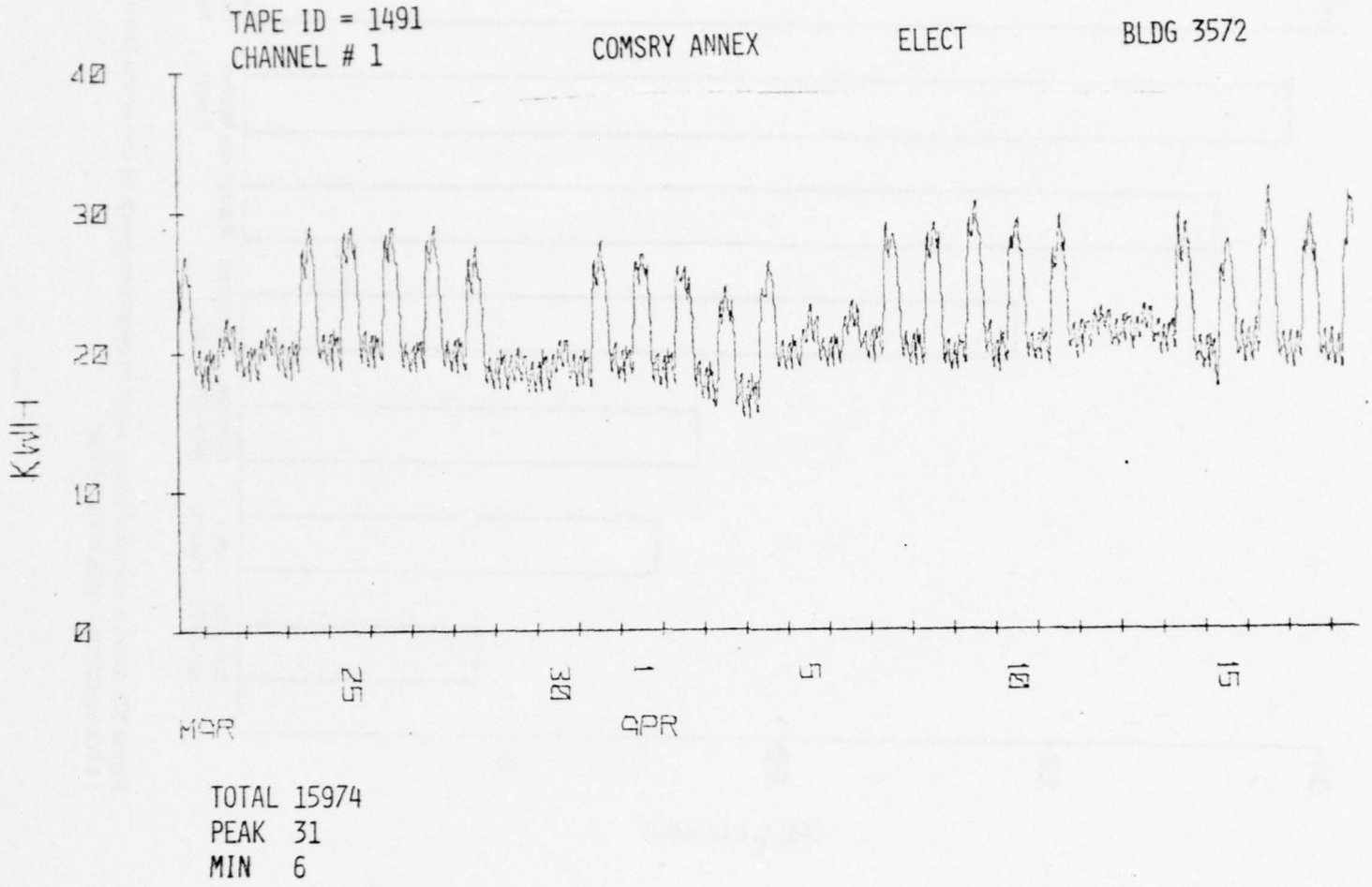


Figure 29. Typical monthly electrical usage profile for a commissary annex at Fort Carson.

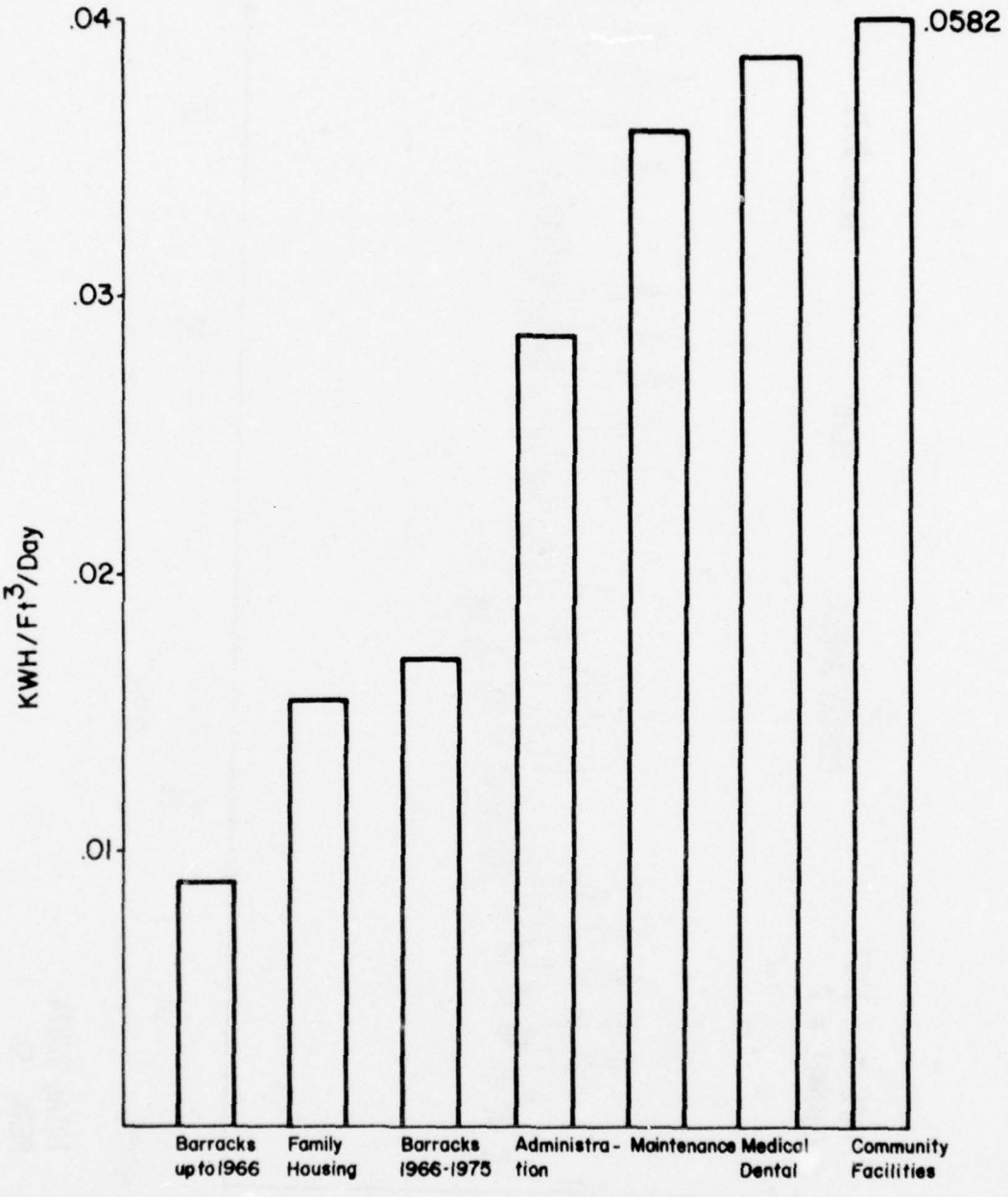


Figure 30. Average electrical energy usage by consumer group. SI conversion factor: 1 kWh/sq ft/day = 10.8 kWh/m²/day.

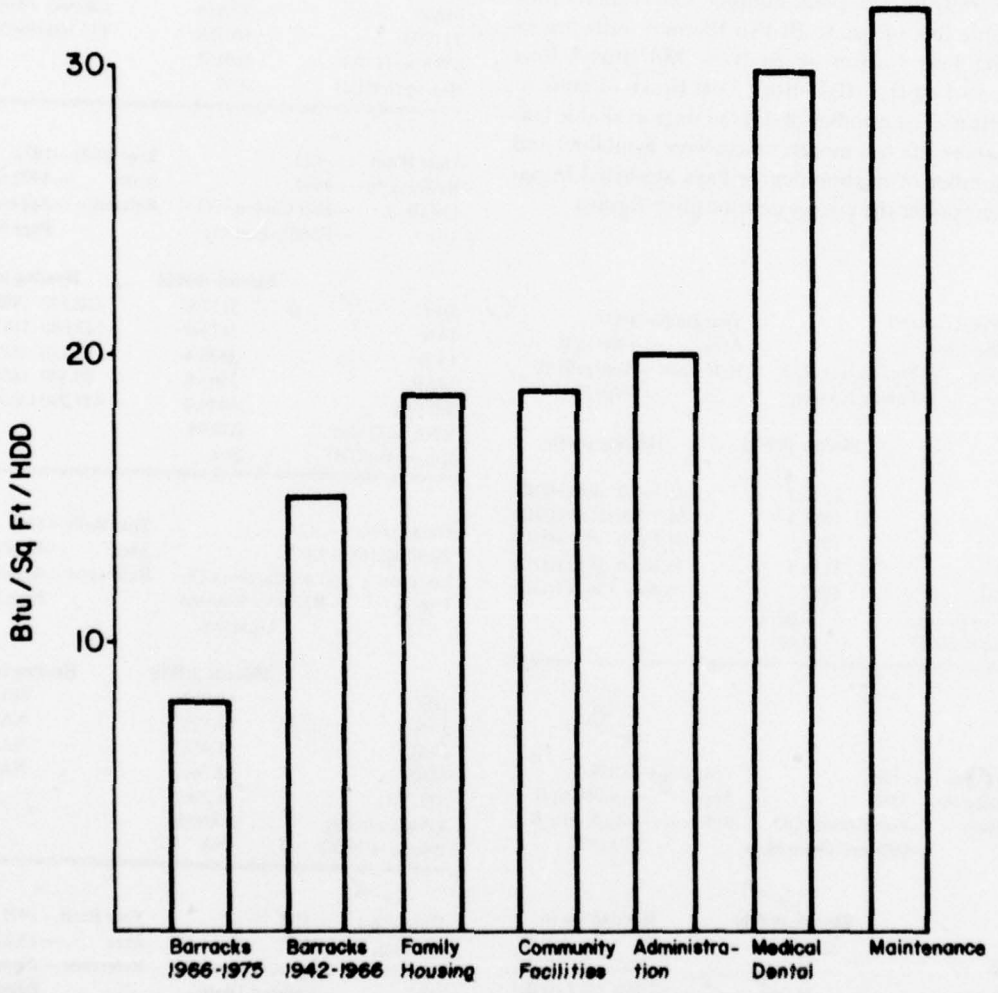


Figure 31. Average gas/oil energy usage by consumer group. SI conversion factor: 1 Btu/sq ft/HDD = 11.4 kJ/m²/HDD.

APPENDIX A:

MONTHLY CONSUMPTION FOR EACH BUILDING

This appendix presents electrical and heating energy usage by month for each of the buildings in this preliminary analysis. The data are arranged numerically by data point number. Conversion ratios for cubic feet of gas to British thermal units are as follows: Fort Carson—1 cu ft = 788 Btus;* Fort Belvoir—1 cu ft = 1031 Btus; Fort Hood—1 cu ft = 1000 Btus. The number of days of data available (except where the full month's data were available) and the number of heating degree days are listed in parentheses after the energy consumption figures.

Data Point —110
Building No.— 17
Location —Fort Carson, CO
Use —Family Housing
Year Built—1957
Area —1906 sq ft
Reference —Appendix B Page 51

	Electric (kWh)	Heating (cu ft)
DEC	1341.3	41,167.0 (988 HDD)
JAN	1318.3	56,718.6 (1181 HDD)
FEB	1091.5	41,594.0 (837 HDD)
MAR	1116.4	36,985.0 (858 HDD)
TOTAL	4867.5	176,464 (3864 HDD)
kWh/sq ft/day	0.0211	
Btu/sq ft/HDD	18.88	

Data Point — 118
Building No.— 7300
Location —Fort Carson, CO
Use —Officers' Open Mess
Year Built—1959
Area —19,089 sq ft
Reference —Appendix B Page 52

	Electric (kWh)	Heating (cu ft)
JAN	39,928	86,530 (1181 HDD)
FEB	35,762	55,950 (837 HDD)
MAR	40,561	63,180 (858 HDD)
TOTAL	116,251	205,660 (2876 HDD)
kWh/sq ft/day	0.0677	
Btu/sq ft/HDD	2.96	

*To avoid confusion, SI equivalents for non-SI units are not given in this appendix. The applicable conversion factors are: 1 cu ft = 0.0283 m^3; 1 Btu = 1.055 kJ; 1 sq ft = 0.0929 m^2; 1 kWh/sq ft/day = 10.8 kWh/m^2/day; 1 Btu/sq ft/HDD = 11.4 kJ/m^2/HDD.

Data Point — 119
Building No.— 7304
Location —Fort Carson, CO
Use —Bachelor Officers' Quarters
Year Built—1970
Area —37,100 sq ft
Reference —Appendix B Page 53

	Electric (kWh)	Heating (cu ft)
NOV		
DEC	16,896	NA
JAN	18,500	NA
FEB	16,454	98,540 (837 HDD)
MAR	17,918	138,560 (858 HDD)
TOTAL	69,768	237,100 (1695 HDD)
kWh/sq ft/day	0.0155	
Btu/sq ft/HDD	2.97	

Data Point — 122
Building No.— 4644
Location —Fort Carson, CO
Use —Family Housing
Year Built—1972
Area —4900 sq ft
Reference —Appendix B Page 54

	Electric (kWh)	Heating (cu ft)
DEC	3117.9	110,140 (988 HDD)
JAN	3179.0	145,680 (1181 HDD)
FEB	2628.4	92,130 (837 HDD)
MAR	2563.8	89,340 (858 HDD)
TOTAL	11489.0	437,290 (3864 HDD)
kWh/sq ft/day	0.0194	
Btu/sq ft/HDD	18.2	

Data Point — 129
Building No.— 1363
Location —Fort Carson, CO
Use —Bachelor Enlisted Quarters
Year Built—1966
Area —42,683 sq ft
Reference —Appendix B Page 55

	Electric (kWh)	Heating (cu ft)
DEC	11,912	NA
JAN	12,173	NA
FEB	11,415	NA
MAR	12,766	NA
TOTAL	48,266	
kWh/sq ft/day	0.00935	
Btu/sq ft/HDD	NA	

Data Point — 130
Building No.— 1040
Location —Fort Carson, CO
Use —Enlisted Dining Facility
Year Built—1971
Area —13,270 sq ft
Reference —Appendix B Page 56

	Electric (kWh)	Heating (cu ft)*
DEC	13,025	NA
JAN	11,906	31,080
FEB	9,964	23,910
MAR	10,749	NA
TOTAL	45,644	54,990
kWh/sq ft/day	0.0284	

*Natural gas used for cooking; heating provided by central plant.

Data Point — 133 Year Built—1974
Building No.—1953 Area —21,280 sq ft
Location —Fort Carson, CO Reference —Appendix B
Use —Bachelor Enlisted Quarters Page 57

	Electric (kWh)	Heating
DEC	12,867	NA
JAN	13,975	NA
FEB	11,881	NA
MAR	12,991	NA
TOTAL	51,714	
kWh/sq ft/day	0.0201	
Btu/sq ft/HDD	NA	

Data Point — 135 Year Built—1971
Building No.—1048 Area —11,990 sq ft
Location —Fort Carson, CO Reference —Appendix B
Use —Administration Page 58

	Electric (kWh)	Heating
DEC	9,830	NA
JAN	9,937	NA
FEB	7,080	NA
MAR	8,053	NA
TOTAL	34,900	
kWh/sq ft/day	0.0241	
Btu/sq ft/HDD	NA	

Data Point — 136 Year Built—1942
Building No.—3471 Area —5310 sq ft
Location —Fort Carson, CO Reference —Appendix B
Use —Bachelor Enlisted Quarters Page 59

	Electric (kWh)	Heating (cu ft)
DEC	1210	NA
JAN	1193	118,946 (1181 HDD)
FEB	968	94,740 (837 HDD)
MAR	873	110,690 (858 HDD)
TOTAL	4244	324,376 (2876 HDD)
kWh/sq ft/day	0.00661	
Btu/sq ft/HDD	16.74	

Data Point — 137 Year Built—1942
Building No.—3472 Area —5310 sq ft
Location —Fort Carson, CO Reference —Appendix B
Use —Bachelor Enlisted Quarters Page 59

	Electric (kWh)	Heating (cu ft)
DEC	1253	NA
JAN	1388	193,497 (1181 HDD)
FEB	983	143,190 (837 HDD)
MAR	1125	121,720 (858 HDD)
TOTAL	4749	458,407 (2876 HDD)
kWh/sq ft/day	0.00739	
Btu/sq ft/HDD	23.65	

Data Point — 138 Year Built—1966
Building No.—2992 Area —26,840 sq ft
Location —Fort Carson, CO Reference —Appendix B
Use —Maintenance Page 60

	Electric (kWh)	Heating
DEC	23,539	NA
JAN	21,381	NA
FEB	21,439	NA
MAR	21,106	NA
TOTAL	87,465	
kWh/sq ft/day	0.0269	
Btu/sq ft/HDD	NA	

Data Point — 139 Year Built—1966
Building No.—2492 Area —26,840 sq ft
Location —Fort Carson, CO Reference —Appendix B
Use —Maintenance Page 61

	Electric (kWh)	Heating (cu ft)
DEC	28,902	1,369,540 (988 HDD)
JAN	32,193	1,456,500 (1181 HDD)
FEB	24,047	1,063,710 (837 HDD)
MAR	24,005	1,056,360 (858 HDD)
TOTAL	109,147	4,946,110 (3864 HDD)
kWh/sq ft/day	0.0336	
Btu/sq ft/HDD	37.58	

Data Point — 147 Year Built—1957
Building No.—1007 Area —3821 sq ft
Location —Fort Carson, CO Reference —Appendix B
Use —Dispensary Page 62

	Electric (kWh)	Heating (cu ft)
DEC	1636	103,570 (988 HDD)
JAN	1623	114,350 (1181 HDD)
FEB	1433	79,400 (837 HDD)
MAR	1715	81,400 (858 HDD)
TOTAL	6407	378,720 (3864 HDD)
kWh/sq ft/day	0.0139	
Btu/sq ft/HDD	20.21	

Data Point — 148 Year Built—1957
Building No.—1430 Area —41,180 sq ft
Location —Fort Carson, CO Reference —Appendix B
Use —Administration Page 63

	Electric (kWh)	Heating
DEC	41,461	NA
JAN	40,358	NA
FEB	36,913	NA
MAR	39,552	NA
TOTAL	158,284	
kWh/sq ft/day	0.0318	
Btu/sq ft/HDD	NA	

Data Point — 149 Year Built—1942
Building No.—3572 Area —2488 sq ft
Location —Fort Carson, CO Reference —Appendix B
Use —Commissary Annex Page 64

	Electric (kWh)	Heating (cu ft)
DEC	16,505	NA
JAN	16,527	85,417 (1181 HDD)
FEB	13,613	64,030 (837 HDD)
MAR	13,751	49,970 (858 HDD)
TOTAL	60,396	199,417 (2876 HDD)
kWh/sq ft/day	0.201	
Btu/sq ft/HDD	21.96	

Data Point — 154 Year Built—1942
Building No.—1544 Area —8044 sq ft
Location —Fort Carson, CO Reference —Appendix B
Use —Administration Page 65

	Electric (kWh)	Heating
DEC	910	NA
JAN	998	NA
FEB	612	NA
MAR	1438	NA
TOTAL	3958	
kWh/sq ft/day	0.0407	
Btu/sq ft/HDD	NA	

Data Point — 210 Year Built—1960
Building No.—1551 Area —2642 sq ft
Location —Fort Belvoir, VA Reference —Appendix B
Use —Family Housing (duplex) Page 66

	Electric (kWh)	Heating (cu ft)
DEC	512 (23 days)	57,034 (612 HDD)
JAN	831 (18 days)	28,954 (705 HDD)
FEB	1026 (28 days)	29,864 (729 HDD)
MAR	1203 (31 days)	20,709 (389 HDD)
TOTAL	3572 (100 days)	136,561 (2435 HDD)
kWh/sq ft/day	0.0135	
Btu/sq ft/HDD	21.885	

Data Point — 211 Year Built—1960
Building No.—1501 Area —2642 sq ft
Location —Fort Belvoir, VA Reference —Appendix B
Use —Family Housing Page 67

	Electric (kWh)	Heating (cu ft)
DEC	390 (23 days)	3,719 (612 HDD)
JAN	693 (18 days)	36,036 (705 HDD)
FEB	1088 (28 days)	36,725 (729 HDD)
MAR	1025 (31 days)	31,159 (384 HDD)
TOTAL	3196 (100 days)	107,639 (2435 HDD)
kWh/sq ft/day	0.0121	
Btu/sq ft/HDD	17.251	

Data Point — 214 Year Built—1960
Building No.—579 Area —2934 sq ft
Location —Fort Belvoir, VA Reference —Appendix B
Use —Family Housing Page 68

	Electric (kWh)	Heating (cu ft)
DEC	1062 (22 days)	33,028 (483 HDD)
JAN	873 (19 days)	38,474 (753 HDD)
FEB	1050 (28 days)	22,784 (414 HDD)
MAR	969 (31 days)	14,696 (203 HDD)
TOTAL	3954 (100 days)	108,982 (1954 HDD)
kWh/sq ft/day	0.0135	
Btu/sq ft/HDD	19,599	

Data Point —219 Year Built—1954
Building No.— 20 Area —66,972 sq ft
Location —Fort Belvoir, VA Reference —Appendix B
Use —Officers' Open Mess Page 69

	Electric (kWh)	Heating (min)
NOV		
DEC	121,229 (22 days)	31,039 (584 HDD)
JAN	50,358 (18 days)	28,006 (705 HDD)
FEB	92,553 (28 days)	17,676 (414 HDD)
MAR	103,901 (31 days)	NA
TOTAL	368,041 (99 days)	76,721 (1703 HDD)
kWh/sq ft/day	0.0555	1279 hrs
Btu/sq ft/HDD	NA	

Data Point —221 Year Built—1975
Building No.—470 Area —108,600 sq ft
Location —Fort Belvoir, VA Reference —Appendix B
Use —Bachelor Officers' Quarters Page 70

	Electric (kWh)	Heating (min)*
DEC	54,441 (22 days)	22,451 (584 HDD)
JAN	44,928 (19 days)	26,749 (753 HDD)
FEB	69,659 (28 days)	15,919 (414 HDD)
MAR	80,489 (31 days)	NA
TOTAL	249,517 (100 days)	65,119 (1751 HDD)
kWh/sq ft/day	0.0230	1085 hrs
Btu/sq ft/HDD	3.994	

*The boilers were fired for a total of 1085 hours during which there were 1751 HDD. According to fuel oil receipts, it appears the firing rate of the boilers is approximately 5 gallons per hour of 140,000 Btus/gal. This would mean a total of 3.994 Btus/sq ft/HDD.

Data Point —222
Building No.—508
Location —Fort Belvoir, VA
Use —Bachelor Officers' Quarters

Year Built 1969
Area —18,360 sq ft
Reference —Appendix B Page 71

	Electric (kWh)	Heating (cu ft)(min)*	
		Gas	Oil
DEC	5,909 (22 days)	7,180 (584 HDD)	11,832 min (22 days) [584 HDD]
JAN	4,745 (19 days)	7,814 (753 HDD)	13,939 min (19 days) [753 HDD]
FEB	8,111 (28 days)	8,982 (729 HDD)	6,749 min (14 days) [414 HDD]
MAR	6,195 (31 days)	5,673 (204 HDD)	
TOTAL	24,961 (100 days)	29,649 (2270 HDD)	32,511 min; 542 hrs (55 days) [1751 HDD]
kWh/sq ft/day	0.01360		
Btu/sq ft/HDD	0.733 gas 16,522 oil		

*Both fuel oil and gas are used in the building. The boiler was fired with oil for a total of 542 hours during which there were 1751 HDD. According to the fuel oil receipts it appears the firing rate of the boiler is approximately 7 gallons per hour of 140,000 Btus/gal. This would mean an additional 16.522 Btus/sq ft/HDD were consumed. Gas is used for cooking.

Data Point — 226
Building No.—2111
Location —Fort Belvoir, VA
Use —Bachelor Enlisted Quarters

Year Built—1975
Area —19,320 sq ft
Reference —Appendix B Page 72

	Electric (kWh)	Heating (cu ft)
DEC	4,944 (23 days)	NA
JAN	4,302 (18 days)	NA
FEB	5,560 (28 days)	NA
MAR	6,425 (31 days)	NA
TOTAL	21,231 (100 days)	
kWh/sq ft/day	0.0110	
Btu/sq ft/HDD	NA	

Data Point —230
Building No.—399
Location —Fort Belvoir, VA
Use —Administration/ Laboratory

Year Built—1973
Area —38,566 sq ft
Reference —Appendix B Page 73

	Electric (kWh)	Heating
DEC	35,186 (23 days)	NA
JAN	30,946 (19 days)	NA
FEB	48,255 (28 days)	NA
MAR	65,665 (31 days)	NA
TOTAL	180,052 (101 days)	
kWh/sq ft/day	0.0462	
Btu/sq ft/HDD	NA	

Data Point — 233
Building No.—1099
Location —Fort Belvoir, VA
Use —Dental Clinic

Year Built—1970
Area —14,188 sq ft
Reference —Appendix B Page 74

	Electric (kWh)	Heating
JAN	8,029 (19 days)	NA
FEB	10,334 (28 days)	NA
MAR	11,682 (31 days)	NA
TOTAL	30,045 (78 days)	NA
kWh/sq ft/day	0.0271	
Btu/sq ft/HDD	NA	

Data Point — 239
Building No.—2120
Location —Fort Belvoir, VA
Use —Post Theater

Year Built—1975
Area —10,650 sq ft
Reference —Appendix B Page 75

	Electric (kWh)	Heating (min)*
DEC	951 (23 days)	29,458 (612 HDD)
JAN	1105 (19 days)	25,530 (753 HDD)
FEB	1142 (28 days)	NA
MAR	850 (31 days)	NA
TOTAL	4048 (101 days)	54,988 (1365 HDD)
kWh/sq ft/day	0.0038	916 hrs
Btu/sq ft/HDD	26.464	

*The boiler was fired for a total of 916 hours during which there were 1365 HDD. According to fuel oil receipts, it appears the firing rate of the boiler is approximately 3 gallons per hour of 140,000 Btus/gal. This would mean a total of 26.464 Btus/sq ft/HDD.

Data Point —319
Building No.—60062
Location —Fort Hood, TX
Use —Family Housing

Year Built—1970
Area —2870 sq ft
Reference —Appendix B Page 76

	Electric (kWh)	Heating (cu ft)
DEC	1579	25,104 (596 HDD)
JAN	1240	35,500 (827 HDD)
FEB	1320	30,260 (345 HDD)
MAR	1008 (29 days)	14,650 (175 HDD)
TOTAL	5147 (119 days)	105,514 (1943 HDD)
kWh/sq ft/day	0.0151	
Btu/sq ft/HDD	18.9	

Data Point —320
Building No.—60100
Location —Fort Hood, TX
Use —Family Housing

Year Built—1970
Area —2870 sq ft
Reference —Appendix B Page 77

	Electric (kWh)	Heating (cu ft)
DEC	1577	39,364 (596 HDD)
JAN	1479	54,297 (827 HDD)
FEB	1505	43,111 (345 HDD)
MAR	1364 (29 days)	29,675 (175 HDD)
TOTAL	5925 (119 days)	166,447 (1943 HDD)
kWh/sq ft/day	0.0173	
Btu/sq ft/HDD	29.8	

Data Point —322
Building No.—5669
Location —Fort Hood, TX
Use —Family Housing

Year Built—1962
Area —2825 sq ft
Reference —Appendix B Page 78

	Electric (kWh)	Heating (cu ft)
DEC	NA	14,961 (596 HDD)
JAN	NA	21,904 (827 HDD)
FEB	NA	15,759 (345 HDD)
MAR	NA	NA
TOTAL		52,624 (1768 HDD)
kWh/sq ft/day	NA	
Btu/sq ft/HDD	10.5	

Data Point —324
Building No.—6443-1
Location —Fort Hood, TX
Use —Family Housing

Year Built—1960
Area —2720 sq ft
Reference —Appendix B Page 79

	Electric (kWh)	Heating (Btu-cu ft-min)
DEC	1235	17,771 (596 HDD)
JAN	1142	22,707 (827 HDD)
FEB	950	15,876 (345 HDD)
MAR	889 (29 days)	10,075 (175 HDD)
TOTAL	4216 (119 days)	66,429 (1943 HDD)
kWh/sq ft/day	0.0130	
Btu/sq ft/HDD	12.57	

Data Point —327
Building No.—180
Location —Fort Hood, TX
Use —Family Housing

Year Built—1951
Area —12,573 sq ft
Reference —Appendix B Page 80

	Electric (kWh)	Heating (cu ft)
DEC	5,315 (28 days)	139,840 (560 HDD)
JAN	6,090	175,520 (827 HDD)
FEB	4,941	111,890 (345 HDD)
MAR	NA	NA
TOTAL	16,346 (87 days)	427,250 (1732 HDD)
kWh/sq ft/day	0.0149	
Btu/sq ft/HDD	19.6	

Data Point —331
Building No.—36006
Location —Fort Hood, TX
Use —Bachelor Enlisted Quarters

Year Built—1969
Area —152,737 sq ft
Reference —Appendix B Page 81

	Electric (kWh)	Heating
DEC	77,928 (29 days)	NA
JAN	94,737	NA
FEB	88,680	NA
MAR	83,621 (29 days)	NA
TOTAL	344,966 (117 days)	
kWh/sq ft/day	0.0193	
Btu/sq ft/HDD	NA	

Data Point —333
Building No.—87017
Location —Fort Hood, TX
Use —Enlisted Dining Facility

Year Built—1974
Area —15,695 sq ft
Reference —Appendix B Page 82

	Electric (kWh)	Heating (Btu-cu ft-min)
DEC	46,391	NA
JAN	49,036	NA
FEB	27,923 (22 days)	NA
MAR	NA	NA
TOTAL	123,350 (84 days)	
kWh/sq ft/day	0.0936	
Btu/sq ft/HDD	NA	

Data Point —339
Building No.—16008
Location —Fort Hood, TX
Use —Bachelor Enlisted Quarters

Year Built—1966
Area —41,907 sq ft
Reference —Appendix B Page 83

	Electric (kWh)	Heating (cu ft)
DEC		431,890 (596 HDD)
JAN	17,516	574,270 (827 HDD)
FEB	15,031	400,160 (345 HDD)
MAR	13,507 (28 days)	156,700 (175 HDD)
TOTAL	46,054 (89 days)	1,563,020 (1943 HDD)
kWh/sq ft/day	0.0123	
Btu/sq ft/HDD	19.20	

Data Point —350
Building No.—32016
Location —Fort Hood, TX
Use —Maintenance
Year Built—1973
Area —11,550 sq ft
Reference —Appendix B Page 84

	Electric (kWh)	Heating (cu ft)
DEC	14,604 (27 days)	202,360 (521 HDD)
JAN	22,788	269,992 (827 HDD)
FEB	16,366	135,478 (345 HDD)
MAR	14,883	113,400 (175 HDD)
TOTAL	68,641 (117 days)	721,230 (1868 HDD)
kWh/sq ft/day	0.0508	
Btu/sq ft/HDD	33.4	

Data Point —352
Building No.—4617
Location —Fort Hood, TX
Use —Maintenance
Year Built—1959
Area —14,000 sq ft
Reference —Appendix B Page 85

	Electric (kWh)	Heating (cu ft)
DEC	13,325	
JAN	15,460	253,460 (827 HDD)
FEB	9,777 (22 days)	148,120 (345 HDD)
MAR	NA	62,750 (175 HDD)
TOTAL	38,562 (84 days)	464,330 (1347 HDD)
kWh/sq ft/day	0.0328	
Btu/sq ft/HDD	24.6	

Data Point —359
Building No.—31002
Location —Fort Hood, TX
Use —Dispensary
Year Built—1972
Area —3808 sq ft
Reference —Appendix B Page 86

	Electric (kWh)	Heating (cu ft)
DEC	2,855 (28 days)	53,940 (536 HDD)
JAN	3,374	70,359 (827 HDD)
FEB	2,880	49,340 (345 HDD)
MAR	2,850 (28 days)	36,490 (175 HDD)
TOTAL	11,959 (115 days)	210,129 (1883 HDD)
kWh/sq ft/day	0.0273	
Btu/sq ft/HDD	29.3	

Data Point —360
Building No.—330
Location —Fort Hood, TX
Use —Dental Clinic
Year Built—1968
Area —9497 sq ft
Reference —Appendix B Page 87

	Electric (kWh)	Heating (cu ft)
DEC	22,381 (26 days)	235,210 (510 HDD)
JAN	23,694	271,720 (827 HDD)
FEB	22,426	137,920 (345 HDD)
MAR	24,242 (28 days)	64,220 (175 HDD)
TOTAL	92,743 (113 days)	709,070 (1857 HDD)
kWh/sq ft/day	0.0864	
Btu/sq ft/HDD	40.2	

Data Point —361
Building No.—1
Location —Fort Hood, TX
Use —Administration
Year Built—1942
Area —12,390 sq ft
Reference —Appendix B Page 88

	Electric (kWh)	Heating (cu ft)
DEC	7,391 (28 days)	176,300 (536 HDD)
JAN	8,473	235,750 (827 HDD)
FEB	7,354	121,310 (345 HDD)
MAR	7,337 (29 days)	54,090 (175 HDD)
TOTAL	30,555 (116 days)	587,450 (1883 HDD)
kWh/sq ft/day	0.0213	
Btu/sq ft/HDD	25.18	

Data Point —363
Building No.—12018
Location —Fort Hood, TX
Use —Gymnasium
Year Built—1966
Area —20,572 sq ft
Reference —Appendix B Page 89

	Electric (kWh)	Heating (cu ft)
DEC	14,821 (28 days)	299,010 (536 HDD)
JAN	14,493	402,839 (827 HDD)
FEB	14,511	255,590 (292 HDD)
MAR	NA	NA
TOTAL	43,825 (87 days)	957,439 (1655 HDD)
kWh/sq ft/day	0.0245	
Btu/sq ft/HDD	28.12	

Data Point —364
Building No.—37017
Location —Fort Hood, TX
Use —Gymnasium
Year Built—1969
Area —20,019 sq ft
Reference —Appendix B Page 90

	Electric (kWh)	Heating
DEC	9,717 (28 days)	NA
JAN	12,342	NA
FEB	11,498	NA
MAR	8,013 (28 days)	NA
TOTAL	41,570 (115 days)	
kWh/sq ft/day	0.0181	
Btu/sq ft/HDD	NA	

Data Point —365
Building No.—16010
Location —Fort Hood, TX
Use —Administration
Year Built—1966
Area —12,180 sq ft
Reference —Appendix B Page 91

	Electric (kWh)	Heating (cu ft)
DEC	9,440	72,410 (596 HDD)
JAN	9,677	107,740 (827 HDD)
FEB	7,743	65,440 (345 HDD)
MAR	6,936 (28 days)	NA
TOTAL	33,796 (118 days)	245,590 (1768 HDD)
kWh/sq ft/day	0.0235	
Btu/sq ft/HDD	11.4	

Data Point —370
Building No.—37010
Location —Fort Hood, TX
Use —Administration

Year Built—1968
Area —12,180 sq ft
Reference —Appendix B
Page 92

	Electric (kWh)	Heating
DEC	6,273	NA
JAN	8,521	NA
FEB	6,067	NA
MAR	5,850 (08 days)	NA
TOTAL	26,711 (118 days)	
kWh/sq ft/day	0.0186	
Btu/sq ft/HDD	NA	

Data Point —374
Building No.—16011
Location —Fort Hood, TX
Use —Administration

Year Built—1966
Area —6136 sq ft
Reference —Appendix B
Page 93

	Electric (kWh)	Heating (cu ft)
DEC	4,996 (28 days)	85,620 (536 HDD)
JAN	5,306	107,260 (807 HDD)
FEB	3,722	63,680 (345 HDD)
MAR	2,290 (28 days)	20,220 (175 HDD)
TOTAL	16,314 (115 days)	276,780 (1883 HDD)
kWh/sq ft/day	0.0231	
Btu/sq ft/HDD	23.95	

Data Point —375
Building No.—23001
Location —Fort Hood, TX
Use —Field House

Year Built—1975
Area —62,000 sq ft
Reference —Appendix B
Page 94

	Electric (kWh)	Heating (cu ft)
DEC	69,910	573,410 (596 HDD)
JAN	74,215	671,740 (827 HDD)
FEB	62,190	384,240 (345 HDD)
MAR	NA	NA
TOTAL	206,315 (90 days)	1,629,390 (1768 HDD)
kWh/sq ft/day	0.0370	
Btu/sq ft/HDD	14.86	

APPENDIX B:

BUILDING DESCRIPTIONS AND PHOTOGRAPHS

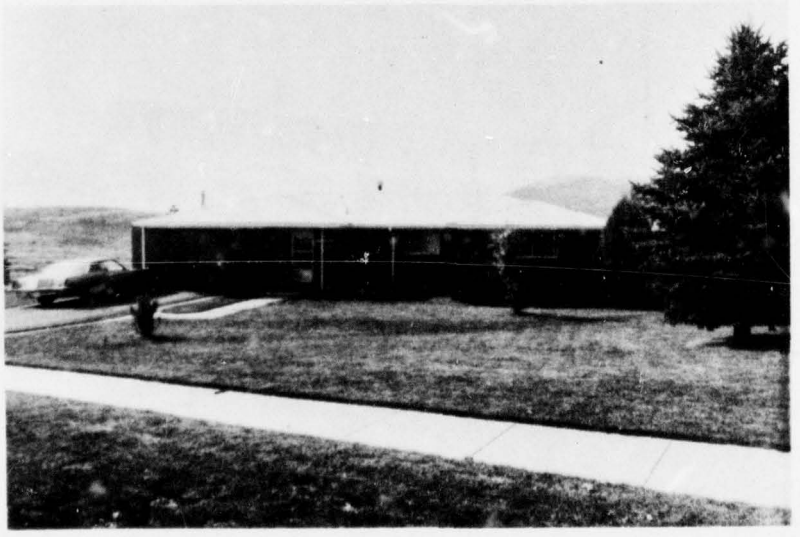
This appendix provides a description and photograph of each building selected for an initial analysis in this report. It provides the year built, the approximate area, and a description of the construction and heating/cooling system of each building. The descriptions are presented in numerical order by data point number.

Fort Carson, CO
Building 17
Data Point 110
Single-Family Housing

Building 17 is one of a complex of single-family houses (buildings 1 through 27) built in 1957 for senior field-grade officers. This one-story house has a total floor area of 1906 sq ft (177 m^2), an overall length of 55.4 ft (16.9 m), and a width of 43.3 ft (13.2 m). The total exterior wall area is 1753 sq ft (163 m^2), of which 14 percent (247 sq ft [23 m^2]) is glass. The combined U-value of the exterior wall is 0.33 Btus/°F-hr-sq ft (1.87 W/°K-m^2), and that of the roof/ceiling is 0.08 Btus/°F-hr-sq ft (0.45 W/°K-m^2).

The house is heated by a ducted warm air system employing a gas-fired furnace of 97,000-Btuh (102 000 kJ/hr) bonnet output capacity.

The energy parameters being monitored in this building are electricity and natural gas.

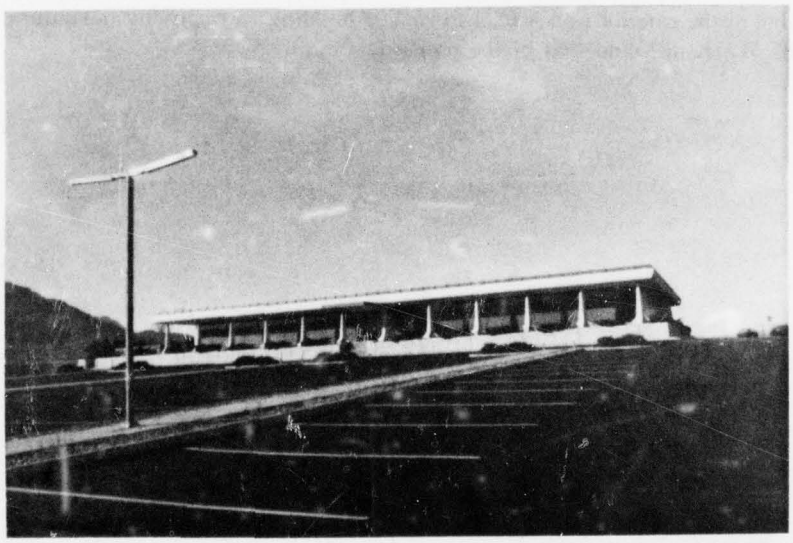


Fort Carson, CO
Building 7300
Data Point 118
Officers' Open Dining Facility

Building 7300 is an officers' open dining facility building constructed in 1959. This one-story brick structure has a total floor area of 19,089 sq ft (1773 m^2). The building dimensions are 160.7 × 113 ft (49.0 × 34 m), plus an offset of 18.7 × 50 ft (5.7 × 15 m). The total exterior wall area is 6980 sq ft (648 m^2), of which 28 percent (1984 sq ft [184 m^2]) is glass. The combined U-value of the exterior wall is 0.47 Btus/°F-hr-sq ft (2.67 W/°K-m^2), and that of the roof/ceiling is 0.23 Btus/°F-hr-sq ft (1.31 W/°K-m^2).

The building is heated and cooled by five roof-mounted, packaged gas-fired heating and vapor compression refrigeration units. The total capacity of the five units is 490,000 Btuh (517 000 kJ/hr) and 862,500 Btuh (910 000 kJ/hr) heating. Three additional roof-mounted, packaged gas-fired heating and evaporative cooling units with a total capacity of 960,000 Btuh (1 013 000 kJ/hr) and 13,500 cfm (6.3 m^3/min) are used to supply makeup air for the kitchen.

The energy parameters being monitored in this building are electricity and natural gas.



Fort Carson, CO
Building 7304
Data Point 119
Bachelor Officers' Quarters (BOQ)

Building 7304 is a BOQ without dining facilities built in 1970. The three-story structure is composed of a primary building 238 × 42 ft (73 × 13 m) and a wing of 55.7 × 42 ft (17.0 × 13 m). The building has a total floor area of 37,100 sq ft (3447 m^2), which includes a basement mechanical room of 994 sq ft (303 m^2). The total exterior wall area is 21,905 sq ft (2035 m^2), of which 16 percent (3464 sq ft [352 m^2]) is glass. The combined U-value of the exterior wall is 0.31 Btus/°F-hr-sq ft (1.75 W/°K-m^2), and that of the roof/ceiling is 0.05 Btus/°F-hr-sq ft (0.28 W/°K-m^2).

The building is heated by a multi-loop, low-temperature, hot-water system employing baseboard radiators located along the inside perimeter. Hot water for heating is supplied by a boiler of 1.28 × 10^6 Btuh (1.35 × 10^6 kJ/hr) output capacity. Ventilation is accomplished through individual ventilation fans serving each room.

The energy parameters being monitored in this building are total electricity and natural gas.

Fort Carson, CO
Building 4644
Data Point 122
Family Housing—Multi

Building 4644 is a one-story fourplex house built in 1972. Each housing unit has a typical width and depth of 40.8 and 30 ft (2.4 and 9.1 m), respectively. The units are arranged end to end, resulting in an overall width of 163.2 ft (49.7 m). The total floor area is 4900 sq ft (455 m^2), and the total exterior wall area is 3180 sq ft (295 m^2), of which 17.5 percent (556 sq ft [52 m^2]) is glass. The combined U-value of the exterior wall is 0.25 Btus/°F-hr-sq ft (1.42 W/°K-m^2); that of the roof/ceiling is 0.90 Btus/°F-hr-sq ft (5.11 W/°K-m^2).

Each housing unit is heated by a ducted warm-air system, each of which employs four gas-fired furnaces of 100,000-Btuh (105 500 kJ/hr) bonnet output capacity.

The energy parameters being monitored in this building are total electricity and natural gas.

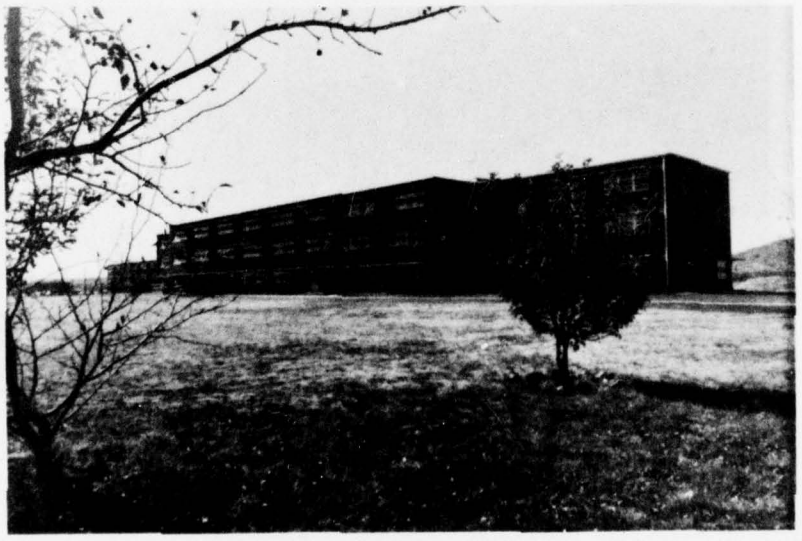
Fort Carson, CO
Building 1363
Data Point 129
Bachelor Enlisted Quarters (Barracks)

Building 1363 is an enlisted personnel barracks building built in 1966 and recently modified. The three-story building has a total floor area of 42,683 sq ft (3965 m^2), which includes a partial basement of 2030 sq ft (189 m^2). The total exterior wall area is 10,230 sq ft (950 m^2), of which 40 percent (4080 sq ft [379 m^2]) is composed of windows and other glass areas. The combined U-value of the exterior wall is 0.50 Btus/°F-hr-sq ft (2.84 W/°K-m^2), and that of the roof is 0.13 Btus/°F-hr-sq ft (0.74 W/°K-m^2).

Heating of the three floors is accomplished by fin-tube radiators located along the perimeter. Hot water for heating is obtained from a shell-and-tube water-to-water converter with a capacity of 1.9×10^6 Btuh (2.0×10^6 kJ/hr). The converter produces low-temperature (180° to 200°F [82° to 93°C]) hot water from medium-temperature (225° to 350°F [107° to 177°C]) hot water supplied from a central plant. Two fans, each with 63,000 cfm (1783 m^3/min) capacity, provide ventilation for the three floors. Chilled water is supplied to the fans from a central plant.

The basement is served by a medium-temperature hot water heating and ventilating unit with a capacity of 262,000 Btuh (276 410 kJ/hr) and 4130 cfm (117 m^3/min). It also includes an exhaust fan of 4000 cfm (113 m^3/min).

The energy parameters being monitored in this building include electricity, chilled water flow, medium-temperature hot water flow, and the chilled and hot water supply and return temperatures.

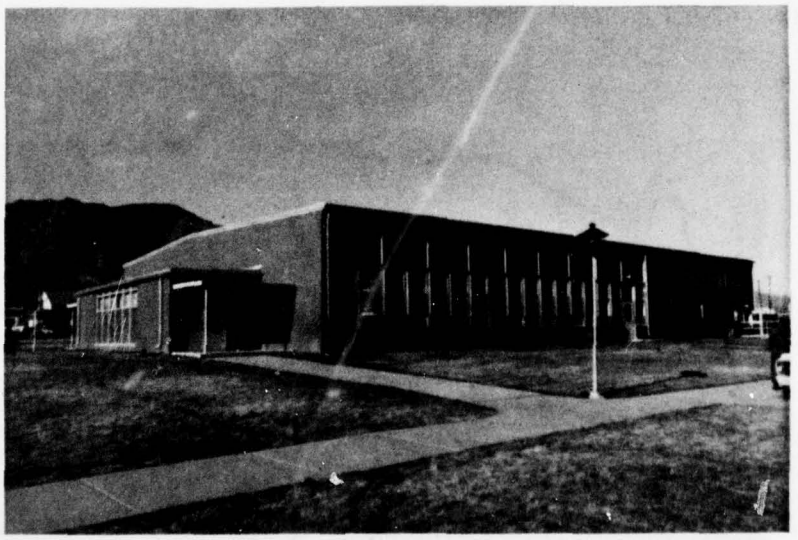


Fort Carson, CO
Building 1040
Data Point 130
Enlisted Dining Facility

Building 1040 is a consolidated dining facility for five companies constructed in 1971. The one-story brick and masonry structure has an overall length and width of 136.2 and 86.3 ft (41.5 and 26.3 m), respectively. The total floor area is 13,270 sq ft (1233 m^2), which includes mezzanine area.

Heating is accomplished by fin-tube radiators located along the perimeter and three air-handling units with a total capacity of 1.03×10^6 Btuh (1.09×10^6 kJ/hr), and 19,000 cfm (538 m^3/min). Ventilation is provided by two fans with 32,000 cfm (1906 m^3/min) total capacity. A converter produces low-temperature (180° to 200°F [82° to 93°C]) hot water for the heating units from medium-temperature (225° to 350°F [107° to 177°C]) hot water generated by a 1.55×10^6 Btuh (1.64×10^6 kJ/hr) low-pressure, gas-fired boiler.

The energy parameters being monitored in this building are electricity, natural gas, and low-temperature, hot-water flow and supply/return temperatures.

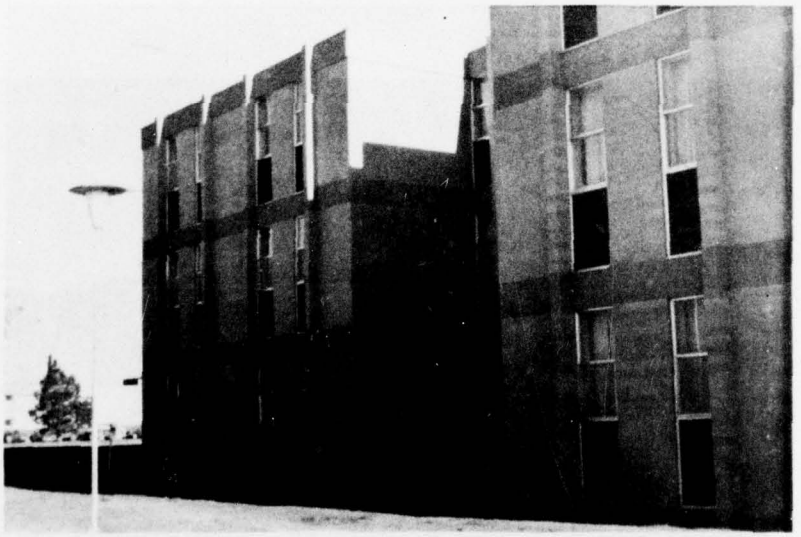


Fort Carson, CO
Building 1953
Data Point 133
Bachelor Enlisted Quarters (Barracks)

Building 1953 is a modular-type enlisted personnel barracks constructed in 1974. The three-story building is composed of two modules connected by a breezeway. Each module is made up of two 46-ft (14 m) deep × 38.7-ft (11.8 m) wide structures connected by a 16 × 16 ft (5 × 5 m) lounge. The total floor area of the building is 21,280 sq ft (1977 m^2). The total exterior wall area is 19,925 sq ft (1851 m^2), of which 12 percent (2398 sq ft [223 m^2]) is glass. The combined U-value of the exterior wall is 0.38 Btus/°F-hr-sq ft (2.16 W/°K-m^2), and that of the roof is 0.11 Btu/°F-hr-sq ft (0.62 W/°K-m^2).

Heating and cooling are accomplished by individual fan-coil units located in each room, corridor, and lounge. Hot and chilled water are supplied from a central plant. A converter is used to produce low-temperature (180° to 200°F [82° to 93°C]) hot water for the fan-coil units.

The energy parameters being monitored in this building include electricity, medium-temperature hot water flow, chilled water flow, and chilled and hot water supply/return temperatures.



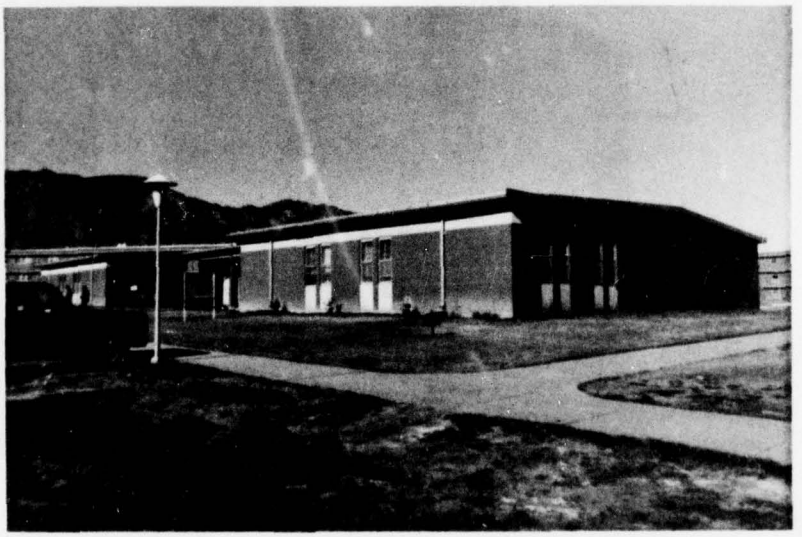
Fort Carson, CO
Building 1048
Data Point 135
Administration Building

Building 1048 is a two-battalion headquarters and classroom building built in 1971. The one-story structure has a total floor area of 11,990 sq ft (1114 m^2), with length of 178 ft (54 m) and width of 77 ft (23 m). The total exterior wall area is 7300 sq ft (678 m^2), of which 8.8 percent (642 sq ft [60 m^2]) is composed of single-glazed windows and other glass areas. The combined U-value of the exterior wall is 0.27 Btus/°F-hr-sq ft (1.53 W/°K-m^2), and that of the roof/ceiling is 0.08 Btus/°F-hr-sq ft (0.45 W/°K-m^2).

The heating system consists of a water-to-water converter, fin-tube radiators, convectors, and fan-coil units. The converter produces low-temperature (190°F [88°C]) hot water for the terminal units from medium-temperature (225° to 350°F [107° to 177°C]) hot water supplied from a central plant.

Cooling is accomplished by three air handling units supplied with chilled water from a 58.6-ton (53.2 t) refrigeration unit with an air-cooled condenser.

The energy parameters being monitored in this building include the electricity, medium-temperature hot-water flow, and supply/return water temperatures.

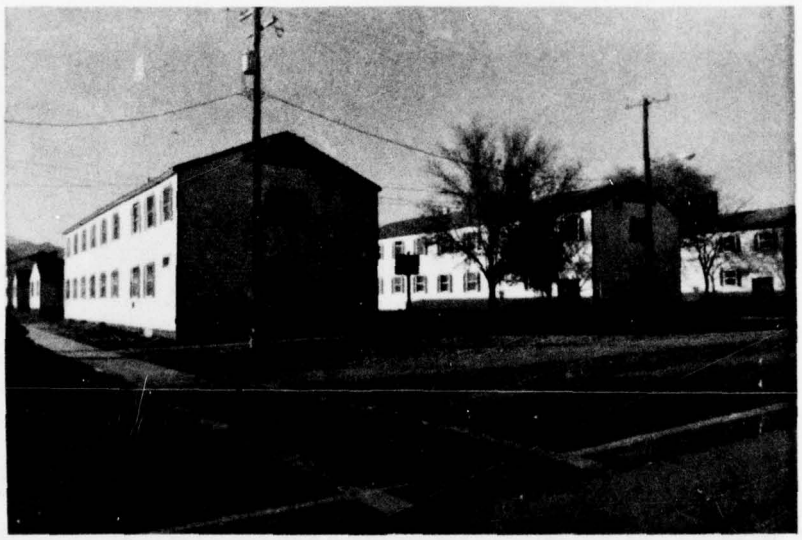


Fort Carson, CO
Buildings 3471 and 3472
Data Points 136 and 137
Bachelor Enlisted Quarters (Barracks—WW II)

Buildings 3471 and 3472 are enlisted personnel barracks constructed in 1942. Each two-story building has a total floor area of 5310 sq ft (498 m^2), an overall length of 90 ft (27 m), and width of 29.5 ft (9.0 m). The total wall area is 4183 sq ft (389 m^2), of which 11 percent (463 sq ft [43 m^2]) is glass. The combined U-value of the exterior wall is 0.34 Btus/°F-hr-sq ft (1.93 W/°K-m^2), and that of the roof/ceiling is 0.21 Btus/°F-hr-sq ft (1.19 W/°K-m^2).

Each building is heated by a 259,000-Btuh (273 245 kJ/hr) gas-fired boiler ducted warm air system employing a gas-fired furnace. The buildings have no air conditioning.

The energy parameters being monitored in these buildings are electricity and natural gas.

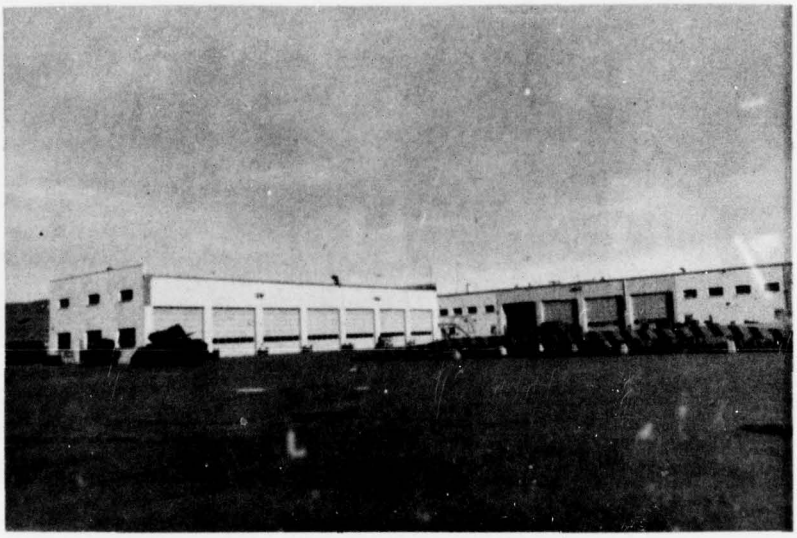


Fort Carson, CO
Building 2992
Data Point 138
Maintenance Shop

Building 2992 is a battalion motor repair shop built in 1966. The L-shaped one-story building has a total ground floor area of 21,060 sq ft (1956 m^2), plus mezzanine floor area of 5780 sq ft (537 m^2). The building dimensions are 151 × 60 ft (46 × 18 m) and 300 × 40 ft (91 × 12 m).

Heating is accomplished by fin-tube radiators located along the perimeter of the building and by unit heaters located in the shop area. Four gas-fired ventilation units with a total capacity of 750,000 Btuh (791 250 kJ/hr) and 10,800 efm (306 m^3/min) provide ventilation to the shop area. Two gas-fired hot water boilers with capacities of 3.37 and 4.5 × 10^6 Btuh (9.96 and 4.75 × 10^6 kJ/hr), respectively, supply hot water to the heating units.

The energy parameters being monitored in this building are electrical and natural gas consumption.

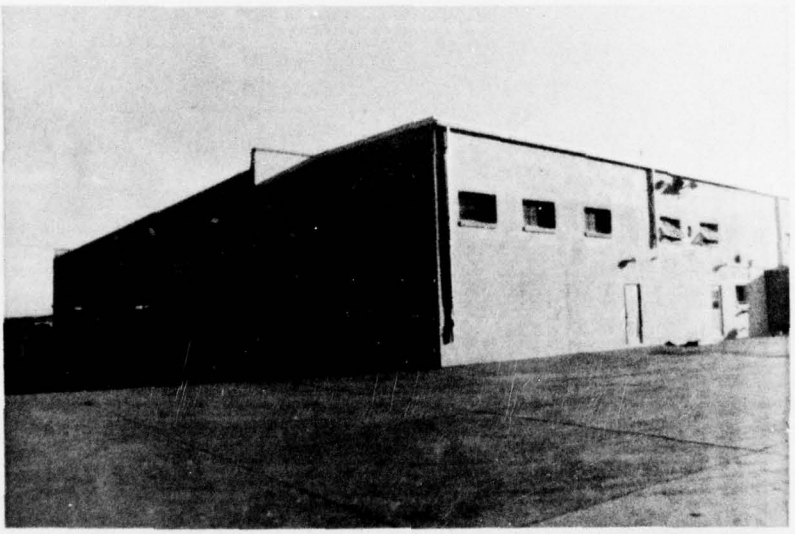


Fort Carson, CO
Building 2492
Data Point 139
Maintenance Shop

Building 2492 is a battalion motor repair shop built in 1966. The L-shaped one-story building has a total ground floor area of 21,060 sq ft (1956 m^2), plus mezzanine floor area of 5780 sq ft (537 m^2). The building dimensions are 151 × 60 ft (46 × 18 m) and 300 × 40 ft (91 × 12 m).

Heating is accomplished by fin-tube radiators located along the perimeter of the building and unit heaters located in the shop area. Four gas-fired ventilation units with a total capacity of 750,000 Btuh (791 250 kJ/hr) and 10,800 cfm (306 m^3/min) provide ventilation to the shop area. Two gas-fired hot water boilers with capacities of 3.37 and 4.5 × 10^6 Btuh (9.96 and 4.75 × 10^6 kJ/hr), respectively, supply hot water to the heating units.

The energy parameters being monitored in this building are electricity and natural gas consumption.



Fort Carson, CO
Building 1007
Data Point 147
Medical/Dental Facility (Dispensary)

Building 1007 is a regimental dispensary constructed in 1957. This one-story structure has a total floor area of 3821 sq ft (355 m^2), with an overall length of 121 ft (37 m), and width of 40.3 ft (12.3 m). The total wall area is 3371 sq ft (313 m^2), of which 12 percent (405 sq ft [38 m^2]) is glass. The combined U-value of the exterior wall is 0.24 Btus/°F-hr-sq ft (1.36 W/°K-m^2), and that of the roof/ceiling is 0.12 Btus/°F-hr-sq ft (0.68 W/°K-m^2).

The building employs a three-zone central system for heating and cooling. An air-handling unit with a capacity of 3300 cfm (93 m^3/min) distributes tempered air to the three zones. A low-pressure, gas-fired steam boiler with an output capacity of 364,000 Btuh (384 000 kJ/hr) supplies steam at 5 psig (34 kPa) to the steam coil. A refrigeration unit of 10.7 tons (9.7 t) capacity supplies refrigerant to the direct-expansion cooling coil.

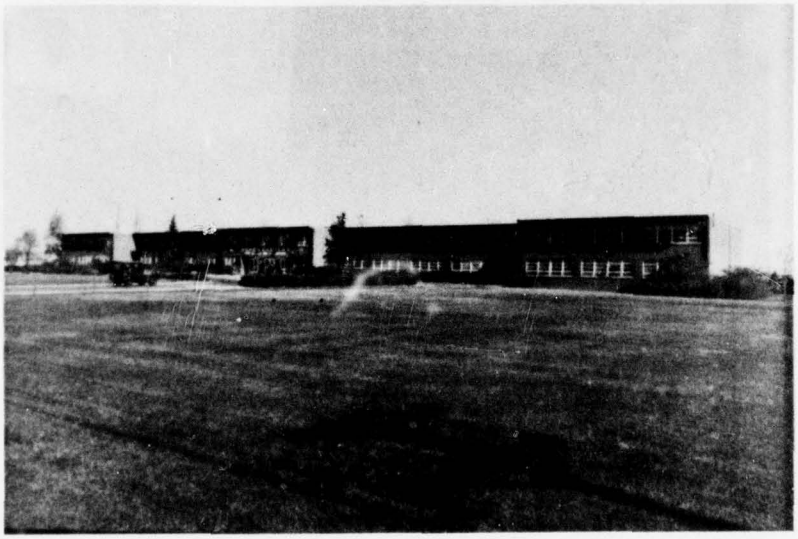
The energy parameters being monitored in this building are electricity and natural gas.

Fort Carson, CO
Building 1430
Data Point 148
Administration Building (Post Headquarters)

Building 1430 is used as post headquarters. The two-story structure built in 1957 has a total floor area of 41,180 sq ft (3826 m^2), which includes a basement floor area of 2590 sq ft (241 m^2). The length and width are 371 and 60 ft (113 and 18 m), respectively. The total exterior wall area is 18,530 sq ft (1721 m^2), of which 34 percent (6300 sq ft [585 m^2]) is glass. The combined U-value of the exterior wall is 0.47 Btu/°F-hr-sq ft (2.67 W/°K-m^2), and that of the roof/ceiling is 0.12 Btu/°F-hr-sq ft (0.68 W/°K-m^2).

Heating is accomplished in three ways. The first and second floors are heated with fin-tube radiators located along the perimeter of the building, with the exception of three rooms which have unit ventilators. The occupied part of the basement is heated by an air-handling unit. All terminal units are served by a two-pipe, low-pressure (15 psig [103 kPa]) steam system, with steam generated by two natural gas 1.13×10^6 Btuh (1.19×10^6 kJ/hr) boilers located in the basement.

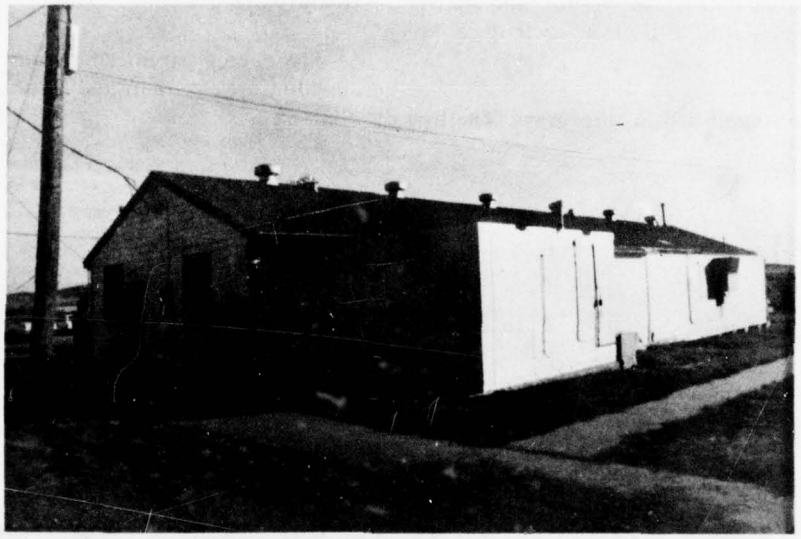
The energy parameters being monitored in this building are electricity and natural gas.



Fort Carson, CO
Building 3572
Data Point 149
Commissary Annex

Building 3572 is a commissary annex building constructed in 1942. The one-story rectangular wood-frame structure is 99.5 ft (30 m) long and 25 ft (8 m) wide. The total floor area is 2488 sq ft (231 m^2). The building is heated by gas-fired unit heaters.

The energy parameters being monitored in this building are electricity and natural gas.



Fort Carson, CO
Building 1544
Data Point 154
Administration Building (WW II)

Building 1544 is an administration building constructed in 1942. The rectangular two-story wood-frame structure has a total floor area of 8044 sq ft (747 m^2). The length and width are 136.3 and 29.5 ft (41.5 and 9.0 m), respectively. The total exterior wall area is 5880 sq ft (546 m^2), of which 19 percent (1099 sq ft [102 m^2]) is glass. The combined U-value of the exterior wall is 0.32 Btu/°F-hr-sq ft (1.82 W/°K-m^2), and that of the roof/ceiling is 0.25 Btu/°F-hr-sq ft (1.48 W/°K-m^2).

Heating is accomplished by radiators with hot water supplied from a 830,000-Btuh (875 650 kJ/hr) gas-fired boiler.

The energy parameters being monitored in this building are electricity and natural gas.

Fort Belvoir, VA
Building 1551
Data Point 210
Family Housing

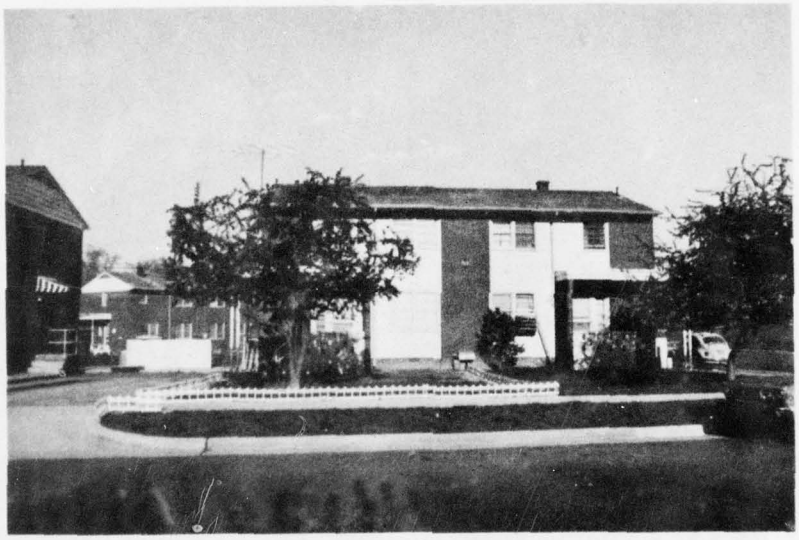
This two-story NCO duplex, built in 1960, encompasses 2642 sq ft (245 m^2). The brick and wood structure employs a wood roof with composition shingles. The building is heated with natural gas. Each unit of the duplex has a 40-gal (1.5 m^3) water heater.

The energy parameters being monitored in this building are electricity and natural gas.

Fort Belvoir, VA
Building 1501
Data Point 211
Family Housing

Built in 1960, this two-story NCO duplex has a total floor area of 2642 sq ft (245 m^2). The brick and wood structure has a wood roof with composition shingles. The building is heated with natural gas. Each unit of the duplex has a 40-gal (1.5 m^3) water heater.

The energy parameters being monitored in this building are electricity and natural gas.



Fort Belvoir, VA
Building 579
Data Point 214
Family Housing—Multi

This 2934-sq ft (273 m^2), two-story, company-grade family housing duplex was built in 1960. The brick and wood structure has a wood rafter roof with composition shingles. The building is heated with gas and has a 40-gal (1.5 m^3) hot water heater. Window air conditioners are used to cool the structure.

The energy parameters being monitored in this building are electricity and natural gas.

Fort Belvoir, VA
Building 20
Data Point 219
Officers' Open Dining Facility

This three-story officers' open dining facility built in 1954 encompasses 66,972 sq ft (6222 m^2). Attached to the three-story main structure is a 4000-sq ft (972 m^2), two-story, eight-person BOQ. Both structures are made of brick and wood and employ a wood rafter system with slate roofing. The building is heated with fuel oil. Twenty-two separate electrical air conditioning units provide cooling.

The energy parameters being monitored in this building are electricity and fuel oil.

Fort Belvoir, VA
Building 470
Data Point 221
Bachelor Officers' Quarters (BOQ)

Built in 1975, this five-story 227-person BOQ encompasses 108,600 sq ft (10 089 m^2). The brick and steel structure employs a reinforced concrete roof slab with composition shingle roofing. The building is heated with oil. It is supplied with 1135 gph (43.0 m^3/hr) of hot water and has 185 tons (168 t) of air conditioning.

The energy parameters being monitored in this building are electricity and fuel oil.

Fort Belvoir, VA
Building 508
Data Point 222
Bachelor Officers' Quarters (BOQ)

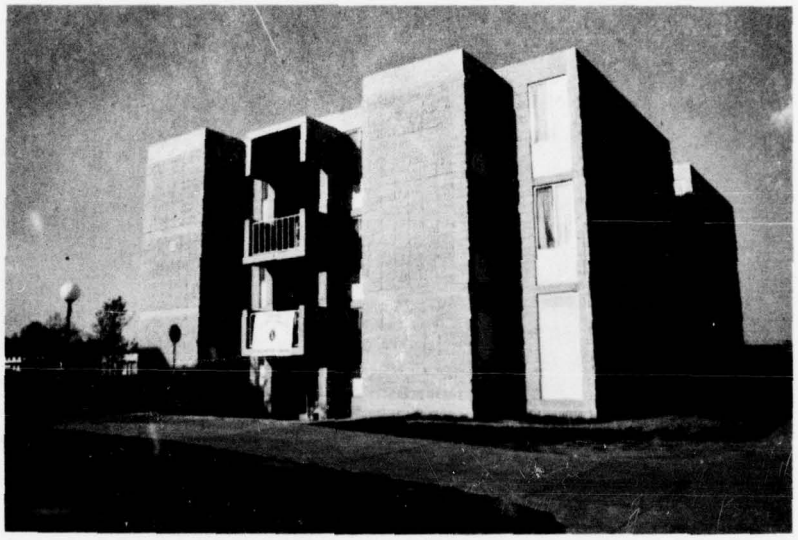
Built in 1969, this two-story, 42-person BOQ encompasses 18,360 sq ft (1706 m^2). The brick and block structure has a steel-joist-supported gypsum roof deck and built-up roofing. It is heated with oil and supplied with 216 gph (8.2 m^3/hr) of hot water. The listed capacity of its air conditioning unit is 207,000 Btuh (218 385 kJ/hr).

The energy parameters being monitored in this building are electricity, natural gas, and fuel oil.

Fort Belvoir, VA
Building 2111
Data Point 226
Bachelor Enlisted Quarters (Barracks)

This three-story, 132-person enlisted barracks without dining facilities has a total floor area of 19,320 sq ft (1795 m^2). The concrete and block building, which was built in 1975, employs a reinforced concrete roof slab with built-up roll roofing. The building is heated with fuel oil. Listed hot water capacity is 285 gal (10.8 m^3). Listed refrigeration capacity is 72 tons (65 t).

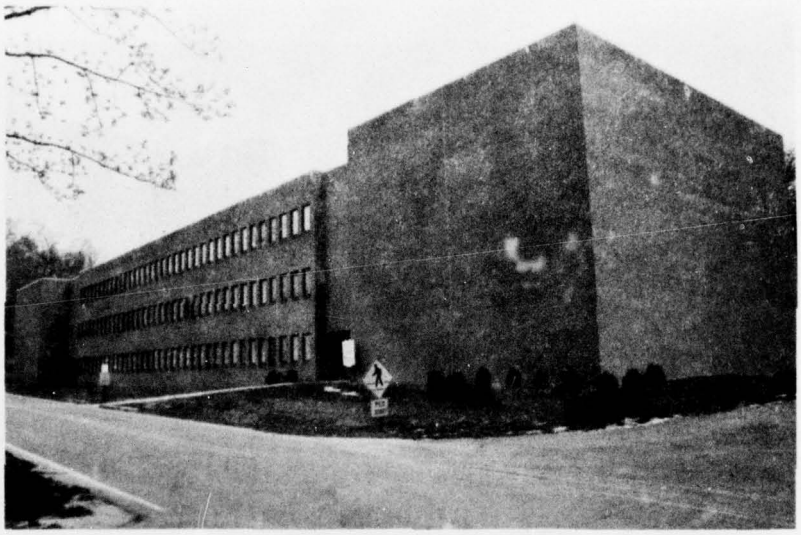
The energy parameters being monitored in this building are electricity and hot and chilled water flow and supply/return temperatures.



Fort Belvoir, VA
Building 399
Data Point 230
Administration/Laboratory

This three-story office and laboratory building built in 1973 encompasses 38,566 sq ft (3583 m^2). The brick and steel structure employs a steel-joist-supported metal roof deck with built-up roofing. The building is heated with gas and has an 80-gal (30 m^3) water heater and 140 tons (127 t) of air conditioning.

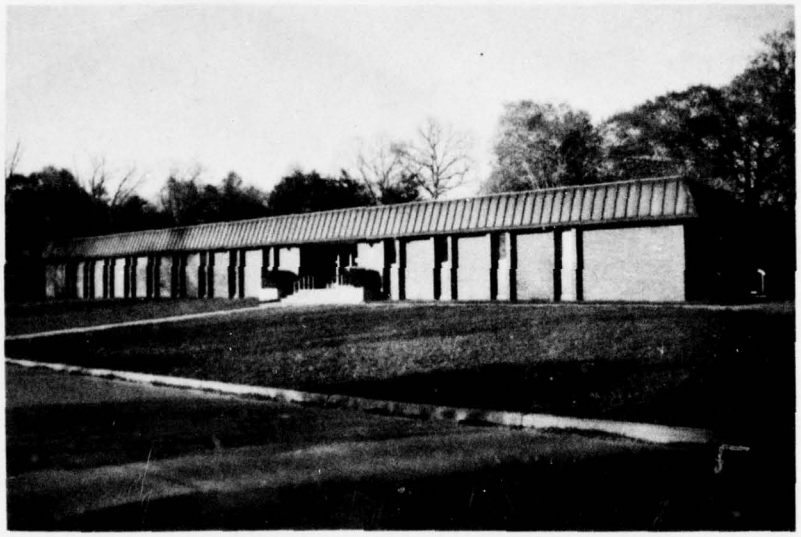
The energy parameters being monitored in this building are electricity and natural gas.



Fort Belvoir, VA
Building 1099
Data Point 233
Dental Clinic

Built in 1970, the single-story dental clinic has a total floor area of 14,188 sq ft (1318 m^2). The block and brick structure employs a wood rafter roof with composition shingles. The structure is heated from a central plant. It is supplied with 252 gph (9.5 m^3/hr) of hot water. Its cooling system is rated at 45 tons (41 t).

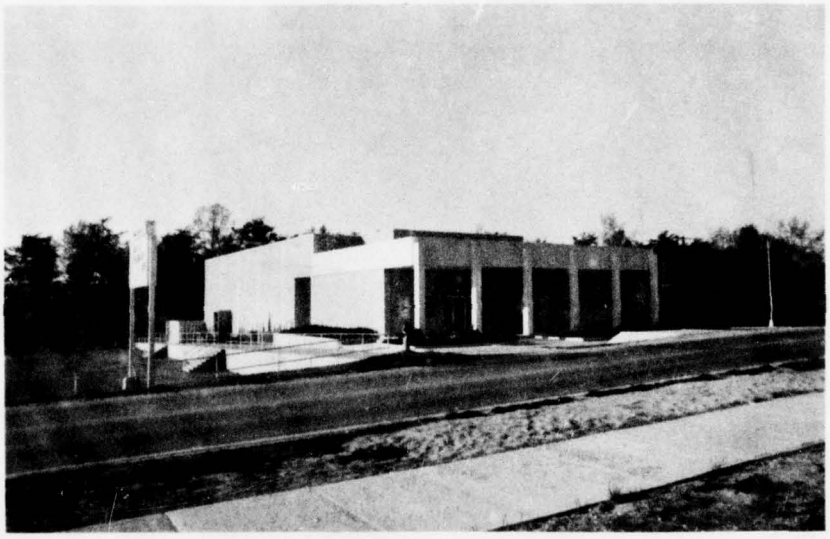
The energy parameters being monitored in this building are electricity and hot water flow and supply/return temperatures.



Fort Belvoir, VA
Building 2120
Data Point 239
Post Theater

Built in 1975, this single-story, 500-seat theater with stage encompasses 10,650 sq ft (989 m^2). The concrete block and steel structure employs a steel-joist-supported metal deck with built-up roofing and gravel. The building is heated with natural gas and fuel oil. It has both a 20-gal and a 40-gal (0.8 and 1.5 m^3) water heater.

The energy parameters being monitored in this building are electricity and fuel oil.



Fort Hood, TX
Building 60062
Data Point 319
Family Housing—Duplex

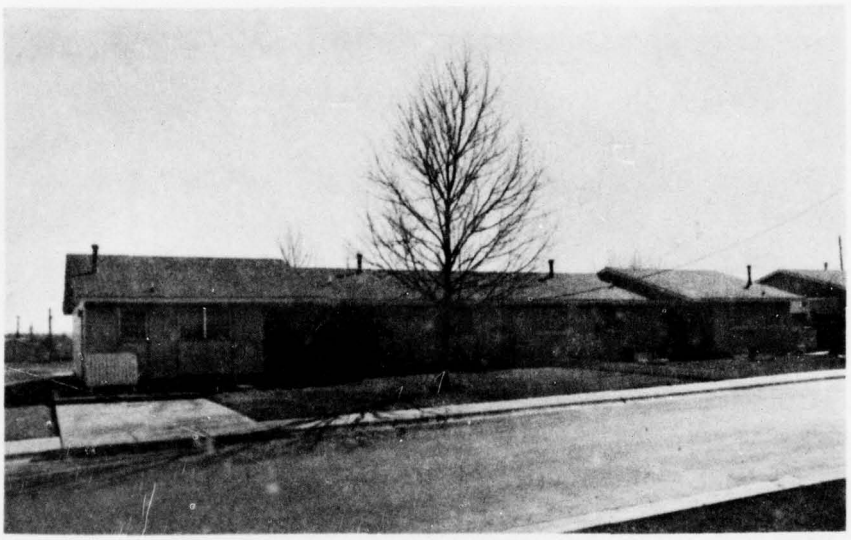
Built in 1970, this single-story NCO family housing-duplex encompasses 2870 sq ft (267 m^2). The wooden structure employs a wooden rafter system with composition shingles. The building is heated with natural gas. Each half of the duplex is cooled with a 2½-ton (2.3 t) air conditioner and serviced by a 40-gal (1.5 m^3) gas water heater.

The energy parameters being monitored in this building are electrical and natural gas usage.

Fort Hood, TX
Building 60100
Data Point 320
Family Housing—Duplex

This single-story family housing-duplex built in 1970 has a total floor area of 2870 sq ft (267 m²). The wooden structure employs a wooden-rafter system with composition shingles. The building is heated with natural gas. Each half of the duplex is cooled with a 2½-ton (2.3 t) air conditioner and is serviced by a 40-gal (1.5 m³) gas water heater.

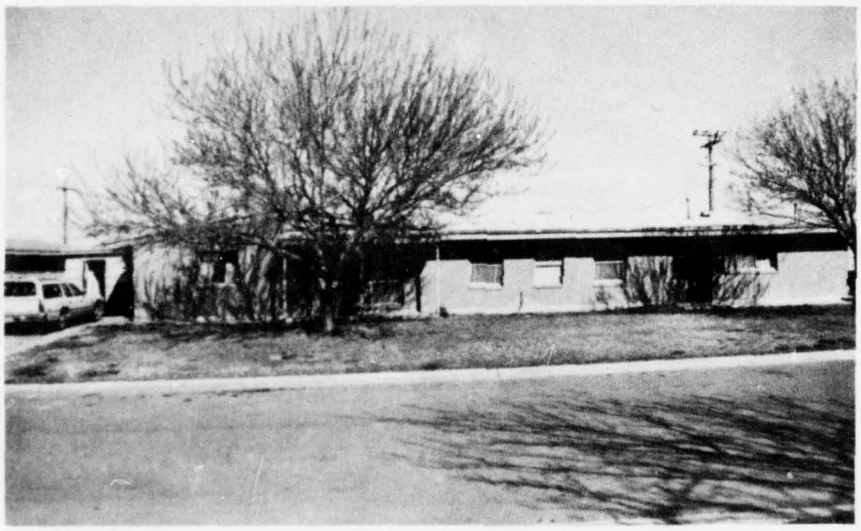
The energy parameters being monitored in this building are electrical and natural gas usage.



Fort Hood, TX
Building 5669
Data Point 322
Family Housing—Duplex

Built in 1962, this single-story, company-grade, family housing-duplex encompasses 2825 sq ft (262 m^2). The wood and brick structure employs a wood-rafter roof system with roll roofing and gravel. The unit is heated with gas and employs a central air conditioner. Listed capacity for the hot water heater is 40 gal (1.5 m^3).

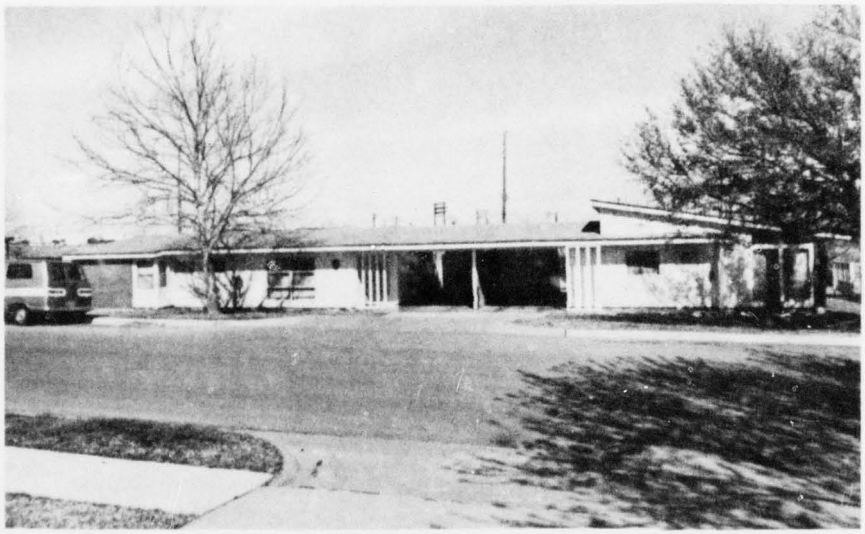
The energy parameters being monitored in this building are electrical and natural gas usage.



Fort Hood, TX
Building 6443-1
Data Point 324
Family Housing—Duplex

Built in 1960, this single-story NCO family housing-duplex encompasses 2720 sq ft (253 m^2). The wood and brick structure employs a wood-rafter system with built-up roll roofing and gravel. Each half of the duplex has an independent heating and cooling system. The hot water capacity is listed as 30 gal (1.1 m^3) at 100°F (38°C) temperature rise.

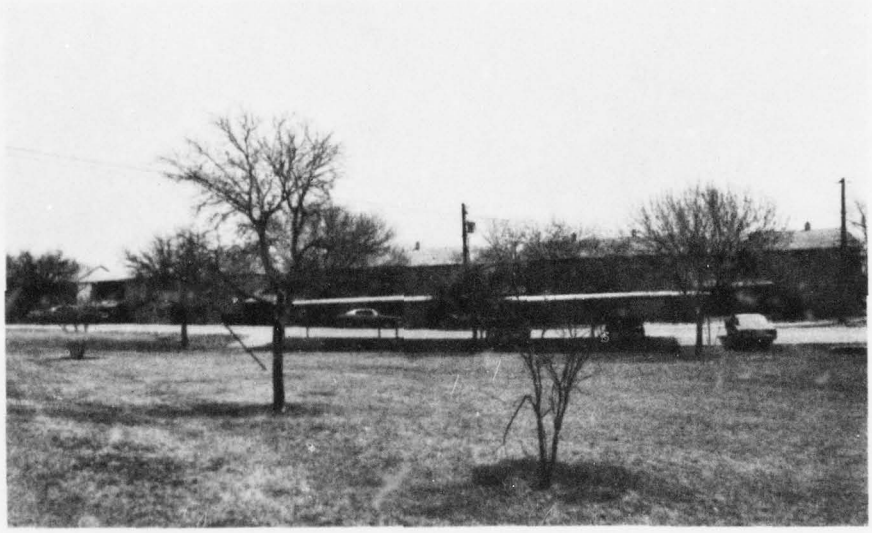
The energy parameters being monitored in this building are electrical and natural gas usage.



Fort Hood, TX
Building 180
Data Point 327
Family Housing—Multi

Built in 1951, this two-story NCO family housing eightplex encompasses 12,573 sq ft (1168 m^2). The brick building employs a wooden-rafter roof system with composition shingles. The building uses individual gas-fired heaters in each unit. Each residence is supplied with a 30-gal (1.1 m^3) hot water heater.

The energy parameters being monitored in this building are electrical and natural gas usage.



Fort Hood, TX
Building 36006
Data Point 331
Bachelor Officers' Quarters (BOQ)

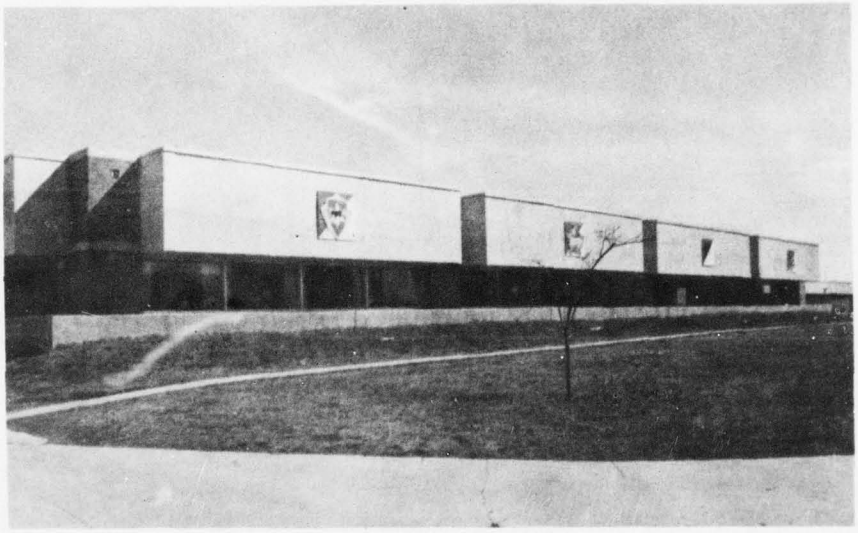
Built in 1969, this six-story, 300-person BOQ has a total floor area of 152,737 sq ft (14 189 m²). The building is concrete and brick with a reinforced concrete roof deck topped with built-up roll roofing (without gravel). The building is heated by a natural gas boiler and cooled with chilled water from a reciprocating central unit with distribution through fan-coil units.

The energy parameters being monitored in this building are electrical and natural gas usage.

Fort Hood, TX
Building 87017
Data Point 333
Dining Facility

Built in 1974, this single-story, 1000-person enlisted dining facility encompasses 15,695 sq ft (1458 m^2) and has dimensions of 108 × 146 ft (33 × 45 m). The concrete block building employs a steel-truss-supported roof deck with built-up roofing. The building is heated with steam supplied by a central energy plant (building 87018). Air conditioning is also supplied from the central plant.

The energy parameters being monitored in this building are electrical usage, natural gas, and chilled water flow and supply/return temperatures.



Fort Hood, TX
Building 16008
Data Point 339
Barracks

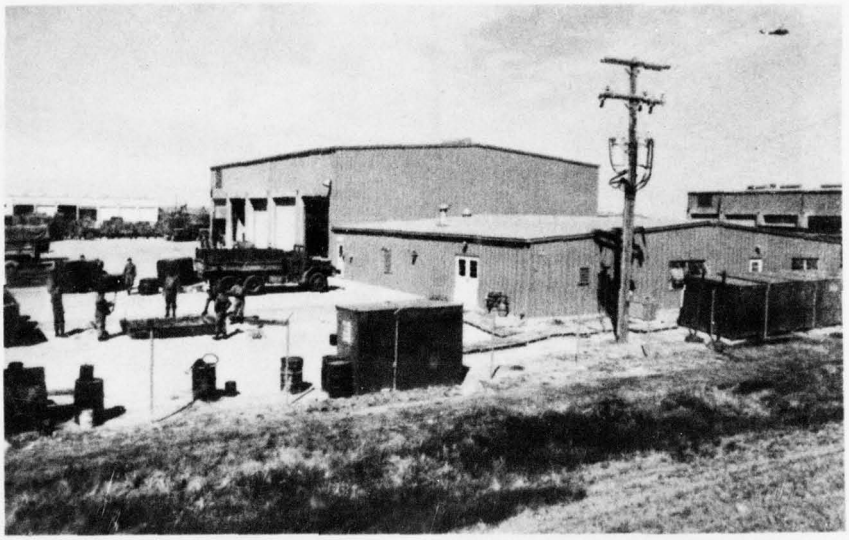
Built in 1966, this three-story, 226-person enlisted barracks covers 41,907 sq ft (3893 m^2). The concrete block and brick building employs a reinforced concrete roof system with built-up roll roofing and gravel. The building has been thermally upgraded and window areas have been reduced by about 40 percent. The structure employs a gas-fired boiler to supply heating.

The energy parameters being monitored in this building are electrical and natural gas usage.

Fort Hood, TX
Building 32016
Data Point 350
Maintenance Shop

Built in 1973, this single-story motor repair shop encompasses 11,550 sq ft (1073 m^2) with dimensions of 70 × 165 ft (21 × 50 m). The steel-walled structure employs a steel-joist-supported galvanized roof. The heating fuel is natural gas. The listed cooling capacity is 8 tons (7 t). A 30-gph (1.1 m^3/hr) gas boiler heater supplies domestic hot water.

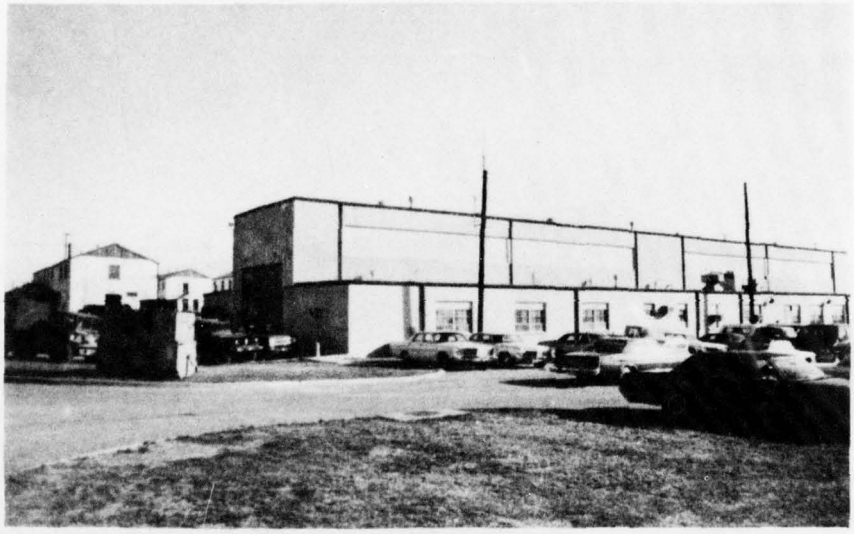
The energy parameters being monitored in this building are electrical and natural gas usage.



Fort Hood, TX
Building 4617
Data Point 352
Maintenance Shop

Built in 1959, this concrete block and steel maintenance shop covers 14,000 sq ft (1301 m^2). Flat steel trusses support a metal roof deck with built-up roofing and gravel. The building is heated with natural gas. It is not air conditioned. The structure is supplied with a 20 gph (0.8 m^3/hr) hot water heater at a 100°F (38°C) rise capacity.

The energy parameters being monitored in this building are electrical and natural gas usage.



Fort Hood, TX
Building 31002
Data Point 359
Dispensary

Built in 1972, this single-story dispensary without beds covers 3808 sq ft (354 m^2), which includes a 47 × 36 ft (14 × 11 m) main section and a 42 × 25 ft (13 × 7 m) offset. The brick and block building employs a steel-arch-supported metal roof deck with built-up roll roofing and gravel. The structure is heated with a natural-gas-fired boiler. The listed capacity of the chiller is 128,000 Btuh (135 040 kJ/hr). Domestic hot water is heated with natural gas at a capacity of 50 gph (1.9 m^3/hr) at 100°F (38°C) rise.

The energy parameters being monitored in this building are electrical and natural gas usage.

Fort Hood, TX
Building 330
Data Point 360
Dental Clinic

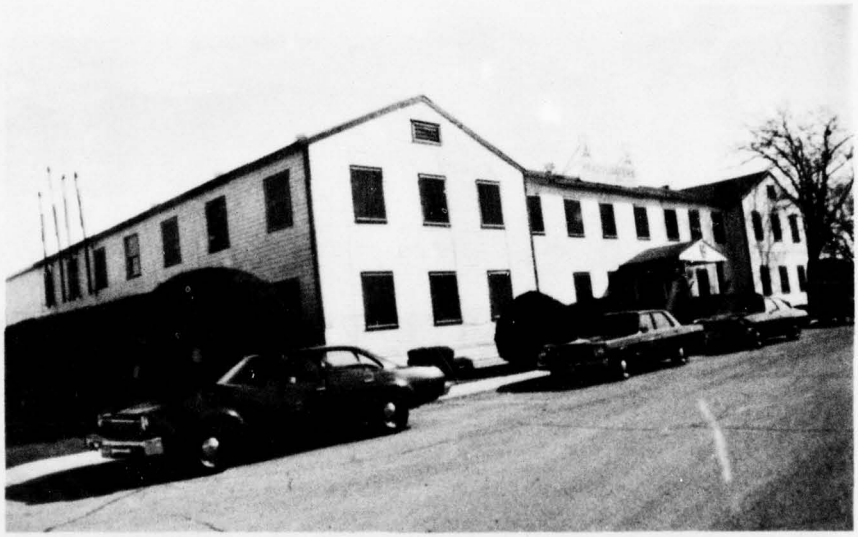
Built in 1968, this single-story, 18-chair dental clinic has a total floor area of 9497 sq ft (882 m²) with dimensions of 93 × 102 ft (28 × 31 m). The block and brick building employs a steel truss roof system with built-up roofing and gravel. The building is heated with natural gas and cooled with a 75-hp (56 kW) chilled water compressor.

The energy parameters being monitored in this building are electrical and natural gas usage.

Fort Hood, TX
Building 1
Data Point 361
Post Headquarters

The 12,390-sq ft (1151 m^2) post headquarters building was built in 1942. Constructed of wood, the structure employs a wood rafter system covered with composition shingles. The building is heated by natural gas.

The energy parameters being monitored in this building are electricity and natural gas.



Fort Hood, TX
Building 12018
Data Point 363
Gymnasium

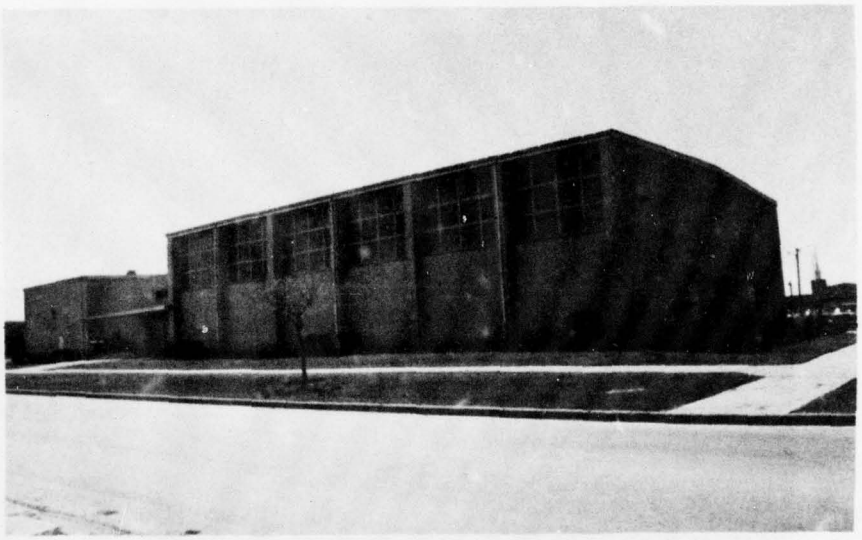
Built in 1966, this 20,572-sq ft (1911 m^2) single-story gymnasium is a concrete block and brick structure employing a steel-joist-supported metal roof deck covered with built-up roll roofing. The building is heated with a gas-fired furnace. It is not air conditioned. The building uses two 300-gph (11.4 m^3/hr) domestic hot water heaters.

The energy parameters being monitored in this building are electrical and natural gas usage.

Fort Hood, TX
Building 37017
Data Point 364
Gymnasium

This single-story gymnasium built in 1969 encompasses 20,019 sq ft (1860 m²), with dimensions of 208 × 100 ft. The block and brick structure employs a steel-joist-supported metal roof deck with built-up roll roofing. The building is heated with a gas-fired boiler. It has no air conditioning system.

The energy parameters being monitored in this building are electrical and natural gas usage.



Fort Hood, TX
Building 16010
Data Point 365
Administration

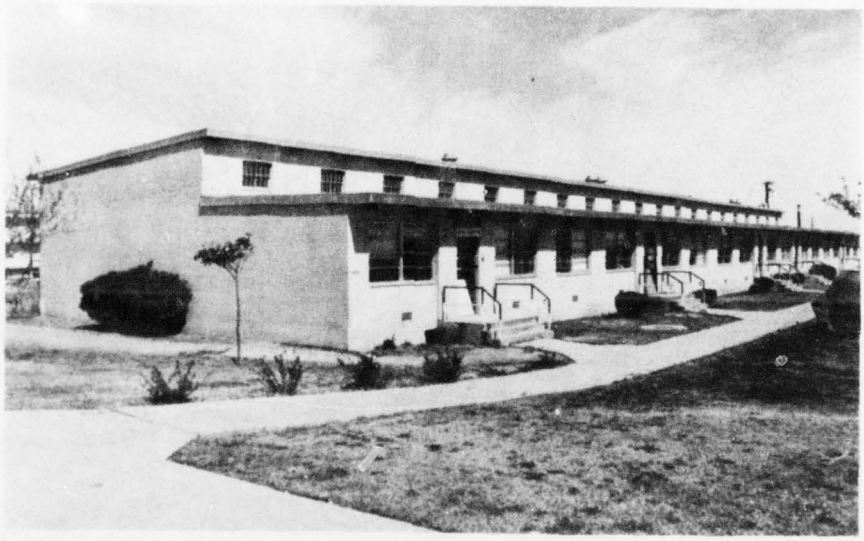
Built in 1966, this single-story administration and supply building covers 12,180 sq ft (1132 m^2) with dimensions of 209 × 57 ft (70 × 17 m). The brick and block building employs a steel-truss-supported metal roof deck with built-up roll roofing and gravel. The building uses a gas-fired boiler and a central air conditioner energy system. Hot water capacity is listed as 70 gal (2.6 m^3) with a 100°F (38°C) temperature rise.

The energy parameters being monitored in this building are electrical and natural gas usage.

Fort Hood, TX
Building 37010
Data Point 370
Administration

Built in 1968, this single-story administration and supply building covers 12,180 sq ft (1132 m^2). The block and brick structure employs a steel-truss-supported metal deck with built-up roll roofing and gravel. The building is heated by a gas-fired boiler.

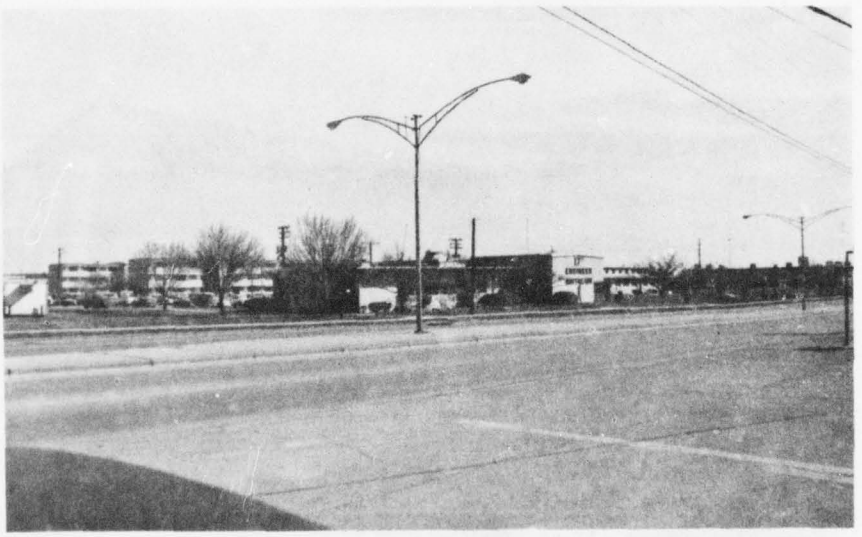
The energy parameters being monitored in this building are electrical and natural gas usage.



Fort Hood, TX
Building 16011
Data Point 374
Administration/Classroom (Headquarters)

Built in 1966, this single-story battalion administration and classroom building encompasses 6136 sq ft (570 m^2), of which 3320 sq ft (308 m^2) are used for administrative space and 2520 sq ft (234 m^2) are used for classroom space. The block and brick structure employs a steel-joist-supported metal roof deck with built-up roofing. The structure is heated with a gas-fired boiler. Hot water is supplied from a 30-gal (1.1 m^3) hot water heater.

The energy parameters being monitored in this building are electrical and natural gas usage.



Fort Hood, TX
Building 23001
Data Point 375
New Field House

Built in 1975, the one-story physical fitness center has a total floor area of 62,000 sq ft (5760 m^2), including 1200 sq ft (111 m^2) of basement. The block and brick building employs a flat steel-truss-supported metal roof deck with a gravel-covered built-up roof. Heat is supplied by a gas-fired boiler. An 82,100 Btuh (86 616 kJ/hr) chiller provides cooling. The listed hot water capacity is 403 gph (15.3 m^3/hr) at 160° to 180°F (71° to 82°C).

The energy parameters being monitored in this building are electrical and natural gas usage.

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Fixed facilities energy consumption investigation : initial energy data / by L. M. Windingland, B. J. Sliwinski. Champaign, Ill. : Construction Engineering Research Laboratory ; Springfield, Va. : available from National Technical Information Service, 1978.
94 p. : ill. ; 27 cm. (Interim report - Construction Engineering Research Laboratory ; E-120)

1. Buildings - fuel consumption. 2. Energy consumption. I. Sliwinski, Benjamin J. II. Title. III. Series: U.S. Construction Engineering Research Laboratory. Technical report ; E-120.